MICROCOMPUTER USAGE BY A LOW VISION STUDENT: A CASE STUDY

JEANNE GLIDDEN MARQUIS

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MICROCOMPUTER USAGE BY A LOW VISION STUDENT:
A CASE STUDY

Jeanne Glidden Marquis

139 Pages | May, 1983

The present study investigated the effects of microcomputer usage on the educational experiences of a low vision student. Ethnographic research methodology was utilized to conduct the study.

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The intent of the present investigation was to observe a low vision high school student over a specified period of time to determine the effects of microcomputer usage on his educational experiences and other experiences.

The investigation was conducted using ethnography, a qualitative research methodology. Participant observation provided data for the study. Interviewing of key individuals in the student's school and home environments provided substantiating data, as did the study of his school records.

The reseacher observed in the high school class settings, at the student's home and in other related situations. Fieldnotes were recorded in raw form, transcribed into final form and organized into fifty-two reports. An item index was developed from the original research questions to analyze observed behaviors. The item index included twenty-two major variables with three to seven subvariables each. Several minor variables were identified during the data analysis. A total of 390 pages of the fifty-two field reports was analyzed. Coding notations were transferred to worksheets for each variable.

The analysis of the data showed that the student was knowledgeable in basic programming concepts and microcomputer usage. He interacted with peers more actively when a microcomputer was involved. The student

read the characters on the video monitor with a negative contrast more readily than he read print with a positive contrast. Microcomputer usage allowed the student to complete homework independently because he could type and read his own work.

The student's self-esteem was heightened through microcomputer usage because he experienced success. The student's expertise was recognized by others around him. The student identified a career goal in computer sciences because of his successful experiences.

The microcomputer was not viewed as a unique adaptation for visual impairment. Microcomputer usage provided the student with a means to participate more fully in a mainstreamed setting.

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The writer wishes to thank, Rob, his parents, his ophthalmalogist, and his physician for their extraordinary contributions to this study. Their willingness to allow the writer into their daily lives initiated the study and ensured its success.

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J. G. M.

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CHAPTER I

INTRODUCTION

The scope of modern technology is advancing at a rapid pace during the second half of the twentieth century. The computer is one of the major technological innovations currently being utilized in industry and a variety of other societal situations. Microcomputers have been developed to expand the utilization of the computer, serving purposes which do not require the use of the sophisticated larger main frame units.

Computers have been used in education for instruction and administration, as well as in training of computer personnel. A variety of uses of microcomputers by handicapped pupils is currently being developed. Blind and low vision pupils have great potential for utilization of the microcomputer. Adaptations have been developed by various manufacturers and computer research teams which enable blind and low vision persons to have access to microcomputers with alternate output formats, such as spoken or braille output modes. The Optacon (Optical to Tactile Converter) has a special attachment for scanning the CRT, the monitor of a microcomputer screen. Some low vision pupils have sufficient residual vision to use the microcomputer without additional sophisticated technology. Microcomputer technology is so new to education that little research exists to date, especially in relation to the applications for special populations. For visually impaired

individuals to share in the benefits of this new technology, they will need to deal with it in some way.

Microcomputers in Education

The current trend toward utilization of computers in a variety of situations and by a variety of populations has led to the development of microcomputers which can be readily available to individuals in homes, schools, and other settings. The use of microcomputers has been infused quite recently into educational curricula and has been found successful in the education of some handicapped children and youth. *Computer*, a journal of the computer science field, has devoted an entire issue to "Computing and the Handicapped" (January 1981). *Exceptional Children*, a special education journal, also has an issue related to the use of microcomputers and the education of handicapped children (November 1982). Microcomputers may "greatly increase job opportunities for the handicapped and homebound" (Hazan, 1981), by allowing individuals to work at home or where adaptations to their needs are facilitated. Individuals with communication disabilities may be enabled to communicate via microcomputer programs.

Giannini (1981), of the National Institute of Handicapped Research, observed that

> from simple calculators to large computers, a wide range of equipment has adaptations for disabled persons. Calculators are easy to input, have a light touch, and can be operated by a mouthstick; talking calculators are available for the blind. . . . Microprocessors and minicomputers are being used for environmental control including the operation of appliances, telephones, television, typewriters, tape recorders, and lighting. (p. 12)

Giannini (1981) cited the work being done in research to utilize computers for rehabilitation of handicapped individuals. Many of the

applications currently being studied involve physical handicaps or communication disorders.

At the Trace Research and Development Center of the University of Wisconsin at Madison, much work has been done to develop applications for microcomputers which will be useful with handicapped pupils. Vanderheiden (1981) listed some major applications which included "educational aids and computer education" (p. 54). Educational individualization can be facilitated; for example, "with microcomputer-based aids, an individual can work on lessons independently, at his own speed" (Vanderheiden, 1981, p. 55). With this potential learning aid, teachers can more effectively utilize active, engaged learning time and individualize to meet IEP objectives. Programs may be written to meet students' unique needs.

As early as 1965, Sterling and Bauman advocated computer training for visually impaired individuals as a vocational choice. The implication for visually impaired children is favorable; if visually impaired adults can become computer programmers, visually impaired children can profit from computer experience as much as nonhandicapped peers might.

Low vision children, especially, could benefit from the use of a microcomputer for daily work. Many more low vision youngsters are currently print readers than have been at any time during the past twenty years. Kirchner, Peterson, and Suhr (1979) review the increase in number of print readers in the legally blind population from 1963 to 1978, for children in graded programs. Many of these students utilize closed circuit television or other enlarging equipment with

the print medium. A video display terminal on a microcomputer unit is similar to any of the currently utilized equipment.

The prevalent use of computers in society, coupled with the increasing use of microcomputers, demands study for educational applications. With the current special education trend toward normalization, special students will receive exposure to microcomputers to "mainstream" them with nonhandicapped peers more effectively. Microcomputer utilization with special education applications will be a valid topic for much research in the years to come.

Ethnographic Research Methodology in Educational Settings

Ethnographic research, used predominantly in anthropology and the social sciences for the study of human behavior, has recently been applied to the study of educational settings (Baker & Jones, 1979; Barton & Brulle, 1981; Davis & Heyl, 1980; Deno, 1980; Erickson, 1973; Erickson, 1977; Everhart, 1977; Marquis, 1982; Smith, 1978; Wilson, 1977; Wolcott, 1970). Ethnographic research methodology allows the researcher to gather data on interaction and change experienced by individuals within educational settings. The researcher may thereby document the learning process more readily than with other traditional methodologies. The behaviors, emotions and reactions which individuals exhibit in such settings can be carefully recorded over time, and interpretations of these behaviors can be checked repeatedly through interviews with the key individuals involved.

"Qualitative methodologies refer to research procedures which produce descriptive data: people's own written or spoken words and observable

behavior" (Bogdan & Taylor, 1975, p. 4). Ethnography is a qualitative research methodology which draws information from sources within the environments of individuals who are studied. A major data source would be information gathered through participant observation.

> The phrase participant observation has not enjoyed a clear definition in the social sciences. It is used here to refer to research characterized by a period of intense social interaction between the researcher and the subjects, in the milieu of the latter. During this period, data are unobtrusively and systematically collected. Observers immerse themselves in the lives of the people and the situations they wish to understand. They speak with them, joke with them, empathize with them, and share their concerns and experiences. Prolonged contact in the setting allows them to view the dynamics of conflict and change and thus see organizations, relationships, and group and individual definitions in process. They therefore enjoy a unique vantage point in relation to the practitioners of other methodologies. (Bogdan & Taylor, 1975, p. 5)

The educational ethnographer involves himself or herself in classrooms, in extraclass school activities, and in activities related to the school environment which are relevant to educational experiences but occur outside of the institutional setting.

Information is substantiated with triangulation. Triangulation involves "comparing data obtained by different methods . . . to provide a coherent view" (Davis & Heyl, 1980, p. 13) during the research process. Several types of triangulation are used in qualitative research. Triangulation of data (Denzin, 1970) involves the study of several data sources. Participant observation yields much information and is regarded as a "rich" data source. "Rich" data are characterized by "great detail and specificity about events studied" (Becker, 1970, pp. 51-52). Interviews and the study of documents or artifacts of a setting also yield data.

In educational research, studying classroom activities and other related settings provides the researcher with detailed information on educational processes for individuals and for groups. The activities and incidents which affect learning and progress are "rich" sources of data for educational researchers.

Purpose of the Study

The purpose of this study was to investigate the impact of microcomputer utilization on the behavior of a single low vision student over a specified period of time. The student was observed to determine the effects of microcomputer utilization on his educational and other experiences. The investigation may have potential applications for educators of low vision students.

Definition of Terms

The following definitions were provided for terms having special application in this study.

Low vision--Low vision includes residual visual acuity measures of 20/200 or less in the better eye with the best correction, or a contraction of the visual field to 20° or less.

Specified period of time--The specified period of time for this study was July, 1982 to February, 1983.

Microcomputer--A microcomputer is a stand-alone computer unit consisting of a keyboard, video display terminal or monitor, and disk drive or cassette drive mechanism. These components are referred to as hardware. The microcomputer may be programmed for word processing, mathematical calculations, and so forth, utilizing program materials

referred to as software. Microcomputer software programs are stored on floppy diskettes or cassette tapes.

Ethnographic research methodology--Ethnographic research methodology is that methodology utilized by anthropology and the social sciences to study cultures. Its goal is the reconstruction and analysis of human behavior from observed incidents, interviews, and the study of artifacts of the culture.

Participant observation--Participant observation provides a primary source of data collection for ethnographic research. It is the actual observation of the cultural situation by the researcher, who records events and dialogue as they occur.

Informants--Informants are the key individuals of a culture or group who provide the ethnographic researcher with data concerning phenomena observed in the culture.

Artifacts--Artifacts are objects, documents, or other concepts unique to a culture.

Effects--Effects includes the influences of the specialized equipment, concepts, and language of microcomputer usage on the subject for this study, and the interactions he experienced with others with the microcomputer as a factor.

Environment--Environment includes the high school classes in which the student participated, selected extraclass situations in which he participated, and his home.

Clarification of Purpose

Delimitations

The limitations imposed on this study were attributed to the field research methodology.

1. The information was collected during six calendar months of the 1982-1983 school year, with two contacts in the summer of 1982.
2. The information was collected from observation of events, from interviews, and from study of artifacts in the environment of the designated subject, including events or situations occurring outside of the educational environment.
3. Information collection and analysis followed ethnographic methodology, with primary application to an educational environment.
4. Although generalizations to populations would be inappropriate, the nature of the study may provide useful information concerning the use of microcomputers by low vision individuals.

Assumptions

The following assumptions were made for the purposes of this study.

1. Educational experiences of a low vision student are influenced by the student's knowledge and use of a microcomputer.
2. All experiences were relevant to this study, with a primary concentration on those experiences or events occurring in the educational environment.

3. The subject of this study already had knowledge of the microcomputer and had been using microcomputers during the past school year.
4. Ethnographic research methodology has significant potential for studying educational environments, offering descriptive and investigative reconstruction of human behavior when statistical comparisons for differences in human performance are less appropriate. Ethnographic research enables the researcher to study human behavior more intensely and qualitatively than statistical comparisons allow.
5. Information can be collected and analyzed utilizing ethnographic research techniques when a study involves low incidence handicapped populations and where large random samples do not exist.
6. Emerging patterns and themes suggested by the data during collection can provide guidance for the reformulation of initial research questions or formulation of new research questions.

Research Questions

This research study was originally formulated around the following research questions.

Research Question 1: What was the influence of microcomputer usage on the environment and experiences of a low vision student?

Research Question 2: What was the effect of microcomputer usage on the interaction of the student with peers?

Research Question 3: What was the effect of microcomputer usage on the interaction of the student with teachers in classes where the microcomputer was utilized for the completion of assignments?

Research Question 4: What was the effect of microcomputer usage on the student's completion of assignments in high school courses?

Research Design and Methodology

This study used ethnographic research methodology to observe a single low vision student functioning within a culture primarily comprised of an educational environment. The student, Robert (Rob), was a senior in a small high school located in a farming community. He attended regular high school classes with resource room help from the teacher for the visually handicapped. Rob's family is middle-class; his father works with computers for a large business in the community. The research was conducted in the settings of school and Rob's home; in both the settings he had access to microcomputers.

The research information collection for the present study included three main sources: field notes from participant observation done by the researcher, notes and audio taped materials from interviews conducted by the researcher, and artifacts. For this study, artifacts were assumed to be documents, objects, or "any things people shape or make from natural resources" (Spradley, 1980). The microcomputer was regarded as an important artifact of the educational environment.

Participant observation was conducted in the high school classes from September, 1982 to January, 1983. Documents were reviewed in the school office in February, 1983. Other contacts started in July, 1982 with the family at home. Interviews were recorded in November, 1982;

December, 1982; January, 1983 and February, 1983.

Field notes were recorded in raw form and transcribed into a microcomputer word processing program. The final volume of field notes included 390 pages of notes on observations, interviews, and the document review. The notes were organized into fifty-two reports. An item index of twenty-two major variables was developed from the research questions and from the patterns of the data. Several minor variables were also recorded within the field notes. The data were analyzed using the item index.

The intense nature of data collection in the methodology through participant observation, interviewing, and the study of documents and artifacts was guided by the researcher's "rationality and scientific attitude" (Schatzman & Strauss, 1973, p. 8). The researcher was the instrument of the methodology, attempting to accurately report and reconstruct the human behaviors observed in the culture. The researcher gathered the information according to Rob's basic class schedule, making adjustments as needed. The researcher formulated conclusions; results of these conclusions are reported in this dissertation document.

The population for this study was Rob, as a single case study. Because the study was done in naturalistic settings, other individuals were instrumental during the information collection process. The members of Rob's family and classmates in school, the ophthalmologist, and the family physician provided information. Other individuals with whom Rob had peripheral contact also provided information for the study. Descriptive statistics were included when the measures provided information useful to analyses of events or situations encountered in the field research.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

Historical Perspectives

Computer technology in business and industry has been available for several decades. In education, the use of computer technology has been available since "the late 1950's" (Bitzer, 1979, p. 553). Computers at that point "had become sufficiently large and reliable for researchers to experiment with their use as a tool to help students learn" (Bitzer, 1979, p. 553). During that period of time, the emphasis on science and mathematics in public education was increasing to meet demands of the space program, and the use of computers in education was a natural outgrowth of the movement. Bitzer (1979) noted that the applications at that time did not include education of exceptional students. "It was not recognized until later that the adaptibility of the computer to the individual users' needs could also be extended to the students who traditionally have been viewed as being handicapped" (Bitzer, 1979, p. 553).

One of the first educational applications of computer technology was the PLATO project which "began in 1960 as a single graphic terminal connected to Illiac I" (Bitzer, 1979, p. 554). The project interfaced smaller terminals placed into schools for students to use with a large main frame unit. PLATO is still in use with students in some educational settings.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

Introduction

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One of the better known projects which interfaced terminals with a main frame unit was conducted at the California School for the Deaf in cooperation with Stanford University. The project was designed to supplement instruction in mathematics and language arts for hearing impaired students. "Later, the Mitre Corporation installed a TICCIT system at the Model Secondary School for the Deaf in Washington, D.C." (Bitzer, 1979, p. 553). These projects were especially appropriate because of the emphasis on visual learning with hearing impaired individuals. The computers assisted students in learning and served also as "a means of written communication among the students" (Bitzer, 1979, p. 554).

As early as 1964, Sterling, Lichstein, Scarpino, Steubing, and Steubing advocated computer training for blind and visually handicapped individuals. They believed that programming was a viable new "profession . . . opened to the blind" (p. 20). Blind persons could be successful at several related aspects of computer work, according to Sterling and Baumann (1965). The cost factors of employing the blind could be minimal, with appropriate kinds of support; blind and sighted programmers could be expected to work at approximately the same speed. Sterling and Baumann reported on a training program for blind programmers and suggested implications for the education of blind children in 1965. Nearly twenty years later the field continued to show a lack of research and a lack of program reports in the area of computers and computer programming.

In the early years of computer programming training for blind individuals, the field tended to be limited to those who were "extraordinary" (Hallenback, 1973, p. 266). These persons were trained individually, often in conjunction with programs for sighted personnel.

Later, training was available in a "specialized training facility" (Hallenbeck, 1973, p. 266). Finally, blind persons have been included with nonhandicapped peers for training at some programs.

The literature in fields of elementary education, secondary education, and special education have recently reflected the increase in production and utilization of personal computers by the general public. Educators are advocating instruction for students which will enable them to make use of the new technology at earlier ages. Computer literacy, or the knowledge and use of the technology, has been the subject of many articles in professional journals in the past three years. Microcomputers have become more accessible to consumers, and earlier prophecies concerning microcomputers have become more nearly a reality.

> Robert Noyce, President of the INTEL Corporation . . . stated that some people currently predict that personal computers, the size of an average dictionary, will be available within the next 5-7 years at less than the cost of one of today's good hand-held calculators. (Watson, 1979, p. 673)

There is no doubt that computers will be an essential element of everyday life for persons in the United States in the future. Computer literacy will be vital for children in every educational setting, including children with handicaps (Cartwright & Hall, 1974; Goldenberg, 1979; Joiner, Sedlak, Silverstein, & Vensel, 1980; Shult, 1978). Watson (1979) observed

> the relevant question today is not whether they will be used to help solve instructional problems of the handicapped but rather how they will be used and how they will affect the education of the handicapped in the next decade. (p. 670)

The brief history of computer usage in education of the handicapped demonstrates a lag on the part of special educators which needs acceleration. Addressing this lag will serve both to improve the normalization

of handicapped students and to generate new ideas for facilitating instruction with the population.

Computer Assisted Instruction

The first uses of computers in educational settings involved instructional supplements for the enhancement of students' skills, primarily in mathematics. Von Feldt (1978) noted that "eleven of the fifty states surveyed have implemented computer based instruction" (p. 11). Most of the computer applications that schools reported were for computer assisted instruction; "a very small percent was allocated for computer science activity" (Von Feldt, 1978, p. 11).

Hart and Staples (1980) saw computer assisted instruction as an extension of the early "teaching machine" (p. 22) concept, as well as an extension of programmed learning. They felt that the new technology was more flexible than either of the other two techniques, because computer programs can be easily changed or updated and "can be stored conveniently" (Hart & Staples, 1980, p. 22). Moreover, teachers would have greater control of the instructional situation because they could write programs which would "instruct the microcomputer to interact in a flexible manner with the student" (Hart & Staples, 1980, p. 22).

Chambers and Bork (1980) reported a public school project which "assessed current and projected use of computers in U.S. public secondary/elementary schools" (p. 5). Drill and practice of basic concepts comprised the major emphases for computer assisted instruction. Secondary schools made more use of the technology than did elementary school programs. "Major usage is in the . . . areas of mathematics, natural sciences, business and language arts" (Chambers & Bork, 1980,

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p. 5). The schools which reported indicated the expectation for greater usage by 1985, primarily with microcomputers.

Several authors advocated the use of microcomputers in every classroom and by every teacher (Ayers, 1980; Blaszczyk, 1981; Eisele, 1979). A variety of possibilities for microcomputer usage were suggested, including computer assisted instruction, the teaching of programming skills, "using the computer as a creative problem-solving tool, and using challenging and entertaining games in the classroom" (Eisele, 1979, p. 13). Computer assisted instruction has been used for more than two decades in public and private education, and will be far more accessible to all teachers with the advent of the smaller, less expensive and more portable microcomputer technology.

<u>Computer Assisted Instruction for Handicapped Students</u>

<u>Hearing Impaired</u>. Since the first explorations of the uses of computer assisted instruction using the PLATO system during the early 1960's, some of the application of the technology has been with hearing impaired students. Watson (1979) observed that "schools and programs for the hearing impaired are utilizing computers more for instructional purposes than administrative purposes" (p. 671). Hearing impaired individuals learn in a visual manner, for the most part, even if the hearing loss is minimal. The visual display of a computer can be an ideal medium for hearing impaired students, especially in consideration of the flexibility with which instructional programs can be written.

Suppes, Fletcher, Zanotti, Lorton, and Searle (1973) reported the results of a program of computer assisted instruction. The program had been instituted with the aid of Stanford University and was primarily

concerned with computational skills of hearing impaired students with mathematics achievement levels of second to sixth grades. Three hundred eight-five students were involved in four states and the District of Columbia.

> Major results of the pretest and posttest data indicated that the computer assisted curriculum enabled hearing-impaired students to achieve gains expected of normally hearing students, that greater number of sessions on the computer were beneficial for all students, and that gains could be achieved in short sessions of 6 to 10 minutes per day. (Suppes et al., 1973, p. 385)

Nomeland (1976) described the progress made at Kendall Elementary School, which is associated with Gallaudet College for the Deaf in Washington, D.C. Hearing impaired students at Kendall had access to drill and practice materials using the curriculum developed at Stanford. "It is estimated that the performance of at least 50 percent of these 48 students improved at least one and a half grades in one year" (Nomeland, 1976, p. 7).

Arcanin and Zawolkow (1980) reported on a project which had been done in conjunction with Stanford at the California School for the Deaf, Berkeley. The Berkeley project established a regional center which has been available as a resource to teachers. The main emphasis of the regional center is assisting teachers in the development of software for their own class purposes in computer assisted instruction. Materials are to be used with microcomputers rather than with time-sharing systems.

The Florida School for the Deaf and Blind also participated with Stanford University in developing a computer assisted instruction program for hearing impaired students (Hoffmeyer, 1980). The project involved computer drill and practice in a number of academic areas, but also included an administrative component which helped teachers follow

students' progress through the materials.

> The process by which the students and the computer communicate with each other is through a name and number system. Each student is assigned a number and within six lessons the students' functional level in mathematics, language, and reading is determined, and the computer "remembers" the progress made by each student. . . . The weekly "readouts" and daily lessons provide the classroom teacher with a guide to meet the individual needs of the students. . . . Each lesson is designed specifically for the student. No other student has exactly the same lesson. (Hoffmeyer, 1980, p. 835)

Students in the Florida School project showed good academic gains. For eighty-five of the subjects, gains of 1.1 years average in mathematics were demonstrated, and for thirty-six of the subjects, the gains were .8 year average over a period of nine weeks with computer assisted instruction in mathematics.

> Deaf children are ordinarily expected to advance one-half school year for each year of instruction. In the Florida School, the gains in mathematics have exceeded this expectation since the introduction of CAI. . . . Such rapid movement cannot, of course, continue over a long period but reflects what can happen when a new method of instruction is presented to handicapped students. (Hoffmeyer, 1980, p. 837)

Microcomputers can be especially appropriate in situations where hearing impaired children are mainstreamed with nonhandicapped peers. In mainstreaming situations, the primary difficulty of hearing impaired students and their teachers is keeping up with the rapidly increasing number of language concepts presented in a regular class setting. Because most hearing impaired children already have a language deficit due to the impairment, resource help often centers around language tutoring. Garvey (1981) described a resource program which utilized microcomputers for language instruction. The use of microcomputers can free the resource teacher to work with several students at a time, as well as allowing students to work on materials developed for the needs of the

mainstreaming situation.

Learning Disabled. Watkins and Webb (1981) cited the lack of good research on the effectiveness of computer assisted instruction as well as the lack of appropriate educational software. They studied twenty-eight learning disabled students in grades one to six (twenty-one males and seven females). Computer assisted instruction in mathematics was used for the experimental group. A control group was matched by sex and grade level. The researchers concluded that computer assisted instruction did raise math achievement levels for learning disabled students.

Hasselbring and Crossland (1982) reported a research project "to develop and field test a microcomputer version of the Test of Written Spelling . . . to determine if examiner time and scoring errors could be reduced" (p. 80). The test was designed with visual and auditory directions, so that it could be used in assessing students with various learning disabilities. "A statistically significant saving was found in the amount of examiner time consumed using the CTWS compared to the paper-and-pencil test version" (Hasselbring & Crossland, 1982, p. 81). Fourteen learning disabled students were tested with the program, which was developed for a TRS 80, Model I microcomputer. Students' typed answers alleviated the problems of poor handwriting characteristic of learning disabled persons, which might be misinterpreted for assessment purposes. The students seemed to work well on the computer, and evaluators were more readily able to count errors.

Hart and Staples (1980) advocated the use of microcomputers with learning disabled students, also. They felt the microcomputer could be

used for instruction, diagnosis, and administrative management. The microcomputer might not be an answer to every need, but "is likely to provide the most sophisticated analytical tool yet made available to the classroom teacher" (Hart & Staples, 1980, p. 25).

Mentally Retarded. Howe (1981) cited a program in Australia which used a computer to teach "basic handwriting skills to severely handicapped children" (p. 44). This method was also adapted to teach blind children how to write, using auditory feedback rather than visual feedback for guidance.

Lally (1980) described a research project in Australia which used computer assisted instruction to help mentally retarded children "acquire the ability to conserve number" (p. 131). The computer gave both visual output and auditory instructions. Subjects showed definite gains in the ability to conserve number although "this ability was to some degree dependent upon the form of questioning used" (Lally, 1980, p. 131). Other writers also cited the effectiveness of computer assisted instruction with mentally retarded students (Loewen, 1981; Winters, Hoats, & East, 1978).

Other Handicaps. Howe (1981) described work with an autistic child which dramatically increased communication with the child, and work with a dyslexic child who improved in academic areas as well as in self-concept when taught some easy programming. The potential of computer assisted instruction for handicapped pupils has been demonstrated many times and with a variety of handicapping conditions. Teaching handicapped children to program can also be beneficial.

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capped children to program can also be beneficial.

Hyperactive children can benefit from computer assisted instruction, also. Kleiman, Humphrey, and Lindsay (1981) reported a study of seventeen subjects with arithmetic problems administered either with a computer or in standard pencil and paper format.

> The differences appeared in the number of problems the children voluntarily chose to do in the two mediums. . . . Apparently, hyperactive children are willing to spend significantly more time working problems on the computer, without any significant loss of accuracy or speed. . . . Many were eager to return and wanted to know when they would have a chance to work on the computer again. None of them requested more paper and pencil drill. (Kleiman et al., 1981, pp. 93-94)

Computer Assisted Instruction for the Visually Handicapped

Overbrook School for the Blind. While computer assisted instruction for the visually handicapped certainly has been instituted in programs around the United States, very few of the programs have reported progress they are making with the technology. Evans and Simpkins (1972) reported a program which was being used at the Overbrook School for the Blind in Philadelphia in grades four to six. The program was designed to supplement classroom mathematics instruction with computer work on a daily basis for drill and practice.

> The program consists of a six grade curriculum with instruction and drill initiated at grade levels appropriate to the child's ability. He advances at his own rate with reviews when necessary. . . . The Braille characters are printed on thin rolls of paper, similar to ticker tape, emitted from a Braille adaptor the size of a briefcase. (Evans & Simpkins, 1972, p. 83)

The portable system was supplied by Triformation, Incorporated, of Rochester, which also produced the standard braille computer terminal. While the braille system provided an appropriate output source for the blind students, "difficulties with the computer program lay in its adaptation for the blind" (Evans & Simpkins, 1972, p. 84). Braille

adaptation alone could not overcome the problems of the setup of arithmetic problems, which would be right-to-left for sighted children, but left-to-right for blind children accustomed to using an abacus for computation. Moreover, the program printed the problems and answers in Grade I braille, rather than Grade II braille, confusing youngsters initially. With training, the children generally adapted (Evans & Simpkins, 1972, p. 84).

Cincinnati Public Schools. Morgan (1975) cited the need for development of computer assisted instruction with handicapped populations. He described a project in the Cincinnati public schools which was designed to implement computer assisted instruction with two populations, hearing impaired and visually handicapped. The visually handicapped group included both print readers and braille readers. Standard curricula were adapted for reading and mathematics. The partially-sighted students had difficulty reading "typewriter-size print on the teletype" (Morgan, 1975, p. 5)., but the blind students had access to a braille printer interfaced to the hardware. The project proved more successful for the hearing impaired population than for the visually handicapped group, regardless of reading medium. The group as a whole had limited participation.

North Carolina State University. At North Carolina State University, blind junior college students were involved in a project which would give them access to the accounting and data processing materials that sighted peers used. The project was to be established to "develop vocal CAI tutorials" (Wilkinson, Cole, & Ballenger, 1976, p. 6.) The authors described the development of hardware they envisioned would permit the

blind undergraduates to have access to the computer assisted learning packages. The rehabilitation project was to be undertaken in conjunction with Pitt Technical Institute. (Later reports of the completed project were not found in the literature.)

George Peabody Project. A project is being conducted currently at George Peabody Teachers' College of Vanderbilt University to investigate various output modes for visually handicapped individuals to use microcomputers. Braille output and speech output are being developed (Ashcroft, 1982).

Problems in CAI Development. The lack of research and project reports concerning computer assisted instruction with the visually handicapped suggests that more development and/or reporting is needed in the area. Visually handicapped students have as much need for these kinds of materials as sighted peers, especially in a mainstreamed setting. The problem of convenient output modes, auditory, braille, enlarged print, and other modes may be delaying progress in the development of software for visually handicapped students. Problems with the conversion of programs to braille formats, as cited by Evans and Simpkins (1972), may be another obstacle.

Several writers advocated the use of computer assisted instruction as a supplement to classroom lessons for a number of reasons, some quite apart from the excellence of the instructional programs which could be developed. The student "finds the machine untiring, predictable and consistent; never getting bored or angry—in short, exhibiting many of the qualities said to be characteristic of a 'good' teacher" (Howe, 1980, p. 17). Drill and repetition "can tax the patience of teachers"

(Hope, 1980, p. 14) and the machine can be programmed to give reinforcement in a flexible manner. The machine is patient and not critical, as a teacher might be. "With microcomputers, handicapped persons who have a slow response rate can work on their lessons independently" (Flaningham, 1981, p. 8). Computer assisted instruction could increase teacher flexibility as well as help students achieve at higher rates with supplementary materials taken at their own rates.

Additional Applications of Computer Technology for the Handicapped

Computer assisted instruction has not been the only area of investigation for educators and others who work with handicapped individuals. Related projects have been proposed, designed and implemented recently.

> Over the past three decades, an intense interaction between applied physical sciences and behavioral sciences has created a field in education known as educational technology. In educational technology, two distinct streams of activities have been developing over this period. One stream is characterized as the application of all kinds of mechanical and electronic tools and instrumentation (i.e., hardware) to the instructional and learning process. . . . The second stream within the field of educational technology can be characterized as a movement that does not refer to hardware per se, but rather refers to the application of various underlying sciences (i.e., the science of behavior and the theoretical frameworks evolving from the fields of communications, cybernetics, perception and linguistic theory) to instructional problems. (Watson, 1979, pp. 671-672)

Some of the educational technology Watson (1979) referred to included computer adaptations which would enable handicapped individuals to use computers for work. Some of the technology included aids to independent living for various handicapping conditions. Hope (1980) concurred with this, citing aids for the communication disabled. "Increasing independence is offered through micro-electronic aids"

(Hope, 1980, p. 14). Teachers would need special training to instruct students in the use of many of the aids, but the outcomes can be desirable long-range independent living.

Johns Hopkins Competition for Technological Aids

Creative Computing (1982) reported the results of a competition sponsored by Johns Hopkins University for new applications of electronic technology to help handicapped individuals. The first prize was awarded for a telephone device for the deaf (TDD) which was created using the TRS 80 pocket computer. Second place was given for "an eye-tracker for communication by severely disabled persons. The system allows a person to cause a word or phrase to become audible by looking at it on a computer screen" (Creative Computing, 1982, p. 54). Another device for hearing impaired individuals, a "lip-reader trainer" (Creative Computing, 1982, p. 54) won third prize. This device used a computer to change typed sentences to graphic mouth movements.

In the Johns Hopkins competition, which was jointly sponsored by the National Science Foundation and Radio Shack (Tandy Corporation), several projects received honorable mention awards. A prosthetic communication system which used a computer was designed for severely disabled persons. "A computer-based system designed to aid students with varying degrees of learning disabilities" (Creative Computing, 1982, p. 55) was shown. An "Ultrasonic Head Control for a wheelchair" (Creative Computing, 1982, p. 55) would give a quadriplegic more independence for everyday activities. A "Firmware Card Training Disk, which turns a computer into a mechanical pencil and paper for the severely disabled" (Creative Computing, 1982, p. 55) was commended.

Three projects given honorable mention were specifically designed to aid the visually handicapped.

> A Micro-Braille system . . . allows production of low-volume, low-cost Braille text using off-the-shelf microprocessor hardware with minor modifications. . . . Raymond Kurzweil of Newton Highlands, MA, received an honorable mention for a Reading Machine for the Blind. It converts ordinary printed or typed materials in any size, style or format or print into unlimited vocabulary, full-word synthetic English speech at speeds up to 1 1/2 times normal speech. . . . The final honorable mention went to Robert E. Stepp III, of Champaign, IL for a Braille Word Processor, an inexpensive, but full-powered Braille word processing system for use by transcribers of both text and non-text, including documents and musical scores. (Creative Computing, 1982, p. 55)

Aids for Independent Living

The value of electronic living aids for the handicapped has recently been emphasized by this competition and by the increasing amount of research being done to develop such aids around the country.

> The handicapping condition caused by the mismatch between individual and environment can be corrected in two ways: the individual's capabilities can be enhanced, or the environment can be modified. (Rahimi, 1981, p. 19)

Puig de la Bellacasa (1980) described a study in Madrid, Spain, of severely disabled individuals, blind, deaf, and deaf-blind individuals within family settings. He noted that new technological aids could

> serve as valuable tools to compensate (complementation or substitution) for the defects of a reduced or wanting communication aptitude in the areas of diagnosis, rehabilitation, special education, direct attendance, daily living and social integration of the disabled. (Puig de la Bellacasa, 1980, p. 199)

Computer, a magazine for the computer science field, addressed the area in the January 1981 issue. Several authors described communication aids for communication disabled persons, especially for the totally nonoral (Foulds, 1982; Rahimi, 1981; Thomas, 1981). Aids for independent living include control systems for wheelchairs which do not require use

of hands, and worktables for the severely disabled which would include devices to work, to self-feed, and to communicate with the outside world (Aylor, Johnson, & Ramey, 1981; Flaningham, 1981; Schneider, 1981). These appliances are controlled with the technology of a microchip and computerized parts (e.g., an arm-movement apparatus).

Several authors noted the potential for severely disabled individuals to work in their own homes as programmers, provided they had the appropriate equipment (Flaningham, 1981; Leneway & Montgomery, 1981; Lincthicum, 1977). Individuals might live several hundred miles from their employers, if the equipment allowed them to exchange information with a company's main systems (Leneway & Montgomery, 1981). These authors described training programs and the adaptations for the severely disabled which have been established.

<u>Aids for the Hearing Impaired</u>

Television has been made more accessible to the hearing impaired with the development of closed captioning (Watson, 1979). This system allows television programs to be captioned on a floppy diskette; the network operates the caption diskette in conjunction with the program. Consumers with the caption decoder may watch the programs with captions which do not appear otherwise. Also for hearing impaired individuals, Brain-Stem Evoked Response (BSER) hearing testing has been developed which enables audiologists to test very young children or others who are incapable of standard responses. The results have been quite accurate, based on brain responses (Flaningham, 1981, p. 1).

The Apple Computer Company (1982) published a guide for disabled individuals which described resources available related to microcomputers.

This pamphlet explains several new applications and gives resources which might be helpful to the disabled in locating specific help. The pamphlet is available from Apple Computer, Incorporated, Cupertino, California.

Technology for the Visually Handicapped

Because visual loss reduces the handicapped person's ability to communicate through print and to learn visually as sighted peers do, a great number of adaptations have been made for visually handicapped students in materials used for educational purposes. Flaningham (1981) and others (Bitzer, 1979; Etlinger & Ogletree, 1981; Howe, 1980; Lunney & Morrison, 1981; Maggs, 1979; Watson, 1979) described several of the most frequently used technological advances for the education of the blind in the past decade.

Reading and Communications Aids

The Kurzweil Reading Machine, described earlier, converts print into spoken output, so that blind persons can have immediate access to print materials. The Speech Plus calculator, developed by Telesensory Systems, Incorporated (TSI) and distributed by the American Printing House for the Blind and by the American Foundation for the Blind, allows the blind individual to compute mathematical problems quickly with speech output. The Optacon (Optical to Tactile Converter), also developed by TSI, uses a handheld camera-scanner to perceive print symbols and convert them to vibrations on a pad of microscopic pins within the unit. The Optacon also gives the user immediate access to print, although the user must perceive and read rather than listen; the Optacon is a much smaller and more portable instrument than the Kurzweil Reading Machine. Etlinger and Ogletree (1981) cited a talking calculator produced by Panasonic.

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Scientific laboratory measuring devices have been converted for use by braille readers, with either braille or auditory cues (Flaningham, 1981; Lunney & Morrison, 1981).

Aids and applicances for reading have been the most widely used in education. Closed circuit television (CCTV), the Visualtek, the Optiscope and other magnification appliances have enabled many low vision individuals to read print, even regular size print. The use of regular size print would save time and cost of reproducing or obtaining enlarged materials. Kirchner, Peterson, and Suhr (1979) reported that the majority of students in public schools who were classified legally blind or visually handicapped nonetheless read print in some form or with some reading aid.

Microfiche as a Reading Aid

Andersson (1977, 1980) studied the potential use of microfiche with low vision individuals to determine if the negative image of the medium was helpful with low vision. He found that three of four "CCTV persons" (Andersson, 1980, p. 193) read faster with the microfiche. Subjects informed Andersson (1977) that they "prefer a negative microfiche, thus permitting light from the apparatus to concentrate only on the text" (p. 37). Andersson's (1977) findings imply that the negative images on the screens of many microcomputer monitors could be helpful to low vision individuals as well. The major problems with microfiche as cited by Andersson (1977, 1980) were the availability of materials and the size of some fiche materials.

Computer Adaptations for Visually Handicapped

Computers are being widely used in business, industry and education. Ways to make the technology accessible to blind persons have been

Scientific laboratory measuring devices have been adapted for use by braille readers, with either braille or auditory output [illegible] (Lowney & Morrison, 1981).

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<u>Computer Adaptations for Visually Handicapped</u>

Computers are being widely used in business, industry and education. Ways to make the technology accessible to blind persons have been

explored. The uses of the Triformation Systems LED-120 braille terminal and similar braille terminals have been cited by many writers (American School and University, 1978; Evans & Simpkins, 1972; Goldish, 1973; Watson, 1979). "Visual display output devices are being used to enlarge hard copy printouts for persons of limited vision" (Watson, 1979, p. 676). Deaf-blind students would also have more immediate access to materials with an adaptation being developed by Gallaudet College.

Maggs (1979) created a speech synthesizer for a computer terminal at the University of Illinois. He noted that the keyboard of the computer does not provide problems to blind students as most learn touch-typing in elementary or secondary classes. At the University of Illinois, "prototype computer terminals" were developed with speech output which "at the same time display each word separately in very large bright letters" (Maggs, 1979, p. 436). The researchers at the University of Illinois attempted to use readily available computer parts obtained from local dealers if possible. Maggs (1979) cited the "problems with existing approaches" (p. 437) which would require the blind person to depend on a human reader, optical character readers (e.g., the Optacon), brailler, or speech synthesis systems which were dependent on complex programs for operation. Human readers present the problem of availability and often may not be familiar with specialized language of the computer field. Optical character readers provide immediate access to materials, but are slow, expensive, and require more specialized training. Braille output mechanisms are slow and limited to blind readers. Maggs (1979) noted that the University of Illinois system would be a "general purpose talking computer terminal" (p. 439) and therefore useful to more than a single population.

Vincent (1982) described a program at the Open University in Manchester, England, which "has made extensive use of computers to support the distance teaching of undergraduate and associate students" (p. 55). Blind students at the university found it difficult to participate, relying on either Optacon or human readers to do the work. A speech synthesizer was developed to solve the problems inherent to both of the other methods. The Open University programs were designed for use with the TRS 80 microcomputer equipment; Vincent (1982) cited the "relatively low cost" and "ease of use" (p. 55).

Computerized braille has been used in the United States and Canada for many years. The equipment available from Triformation Systems (a braille LED-120 terminal) has been widely used. The University of Manitoba, Winnipeg, used the braille terminals for two applications: training blind students as programmers, and providing materials to blind students in the province other than for computer science studies (American School and University, 1978, p. 26). Braille terminals were developed to meet needs in both areas because

> the conventional braillewriter and other braille production equipment--even when electrified or automated--were not rapid enough or convenient enough. What really was needed was a braille equivalent of the conventional terminal. (Goldish, 1973, p. 4)

A more current adaptation of the braille terminal has been used at Florida State University. This instrument was made from "off-the-shelf components" (McConnell, 1982, p. 188) and used a braillewriter which was converted from an IBM office typewriter. The machinery could be interfaced with either the Apple home computer or the TRS 80. McConnell (1982) described the braille printer as providing "hard-copy braille at an affordable price" (p. 188), compared to the more expensive

terminals on the market for main frame use. He noted that the earlier terminals were more like line printers and "not well suited to word processing or other forms of formatted output" (McConnell, 1982, p. 186). Home computers would be more available to most individuals, and the career possibilities for blind persons would be greater with such an adaptation.

Computer Programming for Visually Handicapped

With braille terminals and other output sources, many of the barriers to computer programming for the visually handicapped have been removed. Several writers have observed that potential careers are available to blind programmers (American School and University, 1978; Bishop, 1966; Dalrymple, 1975; Goldish, 1973; Sterling, 1966; Sterling et al., 1964; Talbot, 1982). Emphases on several areas of performance would ensure that the potential could be achieved.

Blind programmers need some access to output, whether by "Optacon, Sagem, Braille-link, Versa-braille, speech output, etc." (Talbot, 1982, p. 68). Access to the information is "necessary for program assembly (listing and memory dump)" (Sterling et al., 1964, p. 21). Programmers have tended not to work in isolation but in constant consultation with other programmers (Bishop, 1966). This characteristic of programming would be beneficial to the blind programmer for quick scanning of program listing to find problem areas. Relying on human readers, as noted earlier, could prove difficult. It could be an option on a less frequent basis than having a permanent modification for output.

Once the modifications have been made for the blind programmer, blind individuals could be expected to perform at a comparable level

to their sighted counterparts. Sterling et al. (1964) believed that blind persons were suited to programming due to intense orientation in an "unseen environment" and "trained memory" (p. 20). Both qualities are essential to programming which requires the ability to think abstractly. Success in the profession would depend on the modification of hardware and "the rapid access to technical material" (Sterling, 1966, p. 8). Blind individuals need to be current in reading of professional materials, which might be difficult to obtain. The blind programmer needs to demonstrate independence and perform comparably with sighted individuals to be a valuable employee.

Several writers stressed the need for quality programs with stringent standards in the training of blind programmers (Committee on Professional Activities of the Blind of the Association for Computing Machinery, 1966; Gildea, 1970; Hallenbeck, 1973; Nichols, 1970; Walker, 1972). During training, blind programmers should be encouraged to develop a portfolio containing "very good documentation of programs. . . written" (Gildea, 1970, p. 298). Gildea (1970) noted that program effectiveness would be established with follow-up of the trainees and their eventual placements (p. 299).

Nichols observed that in 1970, a prevalent attitude of management in business and industry was caution and skepticism (p. 293). Co-workers seemed more ready to accept blind persons as programmers, perhaps because coworkers would see results on a daily basis. Nichols pointed out the need for training programs and blind programmers to stay current with technology, making special efforts to obtain professional materials and keep pace with hardware developments. Royston and Norman (1968) also issued the challenge for blind programmers and training programs

to continue evaluation and follow technological advances. Blind persons trained on obsolete equipment, simply because that was the only thing available, would be difficult to place for permanent jobs.

Training programs for blind individuals in computer programming have been conducted in several ways since the early 1960's. Some training centered around individuals who needed computer expertise and who were trained with sighted peers at various institutions. Modifications were built specifically for them. Others were trained in specialized programs. Several writers described training programs which are summarized in the following paragraphs.

Bishop (1966) reported on a program established at the computer sciences laboratory at the University of Southern California in 1965. The experimental training project was initiated to determine the extent to which blind individuals could be trained for computer programming at USC. The project emphasized assembler/compiler languages. Those responsible for the project did not feel that a braille terminal was the only answer for independence of blind programmers, but did see the need for blind persons to remain current with the state of the art. The project was eventually disbanded due to facilities and personnel problems (Bishop, 1966, p. 40).

In 1966, System Development Corporation of Santa Monica, California was approached to "design a curriculum and undertake the instruction of blind and visually impaired programmers. . . . It was decided that course content whould be as rigorous as that provided for sighted employees" (Walker, 1972, p. 98). Walker (1972) also stressed the concept that the programmer must be functionally independent when placed into a job, going "into a computer installation without requiring

to continue evaluation and follow [illegible] trained on obsolete equipment, [illegible] available, would be difficult [illegible]

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In 1970 [illegible] California [illegible] instruction of blind and visually impaired programmers [illegible] decided that course content should be as rigorous as that provided for sighted employees" (Walker, 1972, p. 90). Walker (1972) also stresses the concept that the programmer must be functionally independent when placed into a job, going "into a computer installation without requiring

modifications to the equipment or procedures just to accommodate him" (p. 101). The program had fifty-three graduates between 1966 and 1972. Walker (1972) cited several qualities of blind persons which make them good candidates for programming careers: "retentive memory, analytic thought processes, attention to detail, ability to handle coded forms of communication" (p. 96) and similar traits. The training program was uncompromising in requiring a high level of skill from the blind individuals enrolled in it.

> The students are encouraged to develop individual techniques in handling tasks—reading cards, segmentation of programs, etc., that will assist them in their independence. There will be times, of course, when they may need to "borrow a pair of eyes," but this is not unusual. Programmers tend to work together and help each other. Braille printouts are discouraged although a conversion program is available for any student who wishes it. (Walker, 1972, p. 101)

The eight month course provided about one hundred twenty classroom hours per month. Walker cited the program as an example of the quality standards that should be generally accepted for this kind of training. Charleston, Sheffield, Sigl, and Millen (1976) also reported on the System Development Corporation training program. They noted that the program was successful over ten years "due primarily to intensive screening and realistic selection of candidates for the training, high standards in the conduct of the training, and professional ethics in the placement of the students" (Charleston et al., 1976, p. 2).

In 1963 a project was initiated at the Medical Computing Center of the University of Cincinnati "to explore the extent to which computers can aid in the rehabilitation of the blind" (DeRuyter, 1968, p. 7). One paraplegic blind individual was trained first. As obstacles were met in the course of training (e.g., no braille output or other usable form of

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Walker (1971) ...

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of the University of Cincinnati "to evaluate ... as an aid in the rehabilitation of the blind." However, ... paraplegic blind individual was trained first ... the course of training (e.g., no braille output or other ...

output), devices and aids were developed to meet the needs.

Schiff (1968) cited a lack of manpower in Israel as instrumental in the establishment of computer programming training for blind persons in that country. He noted that there was "no precedent in Israel or in other Western countries for employment of blind persons in the field of IBM machine operations of computer programming" (Schiff, 1968, p. 2). The program development included blind individuals first, then expanded to involve persons with other disabilities as key punchers and data processors. The IBM corporation cooperated and consulted with the program developers.

The Union of Soviet Socialist Republics (USSR) also developed training sequences for blind computer programmers (Zimin, 1968). Special courses of training were not established, but blind persons were trained with sighted peers. In the USSR, blind persons in computer programming were expected to "have higher mathematical education, since they must be able to work out the proper mathematical system of equations in order to transfer these equations to algorithms" (Zimin, 1968, p. 307). Zimin indicated that blind programmers performed equally to their sighted peers, with the appropriate training.

Alford (1969) presented a case study of a diabetic blind individual who was trained as a computer programmer, on an individual rehabilitation basis. The individual had been an engineering aide, and had the background in mathematics and science necessary for programming. The major problem in training was the lack of available manuals for the student; "manuals for the 360 were not available on tape on in braille" (Alford, 1969, p. 48).

The Rolls-Royce automobile manufacturing corporation had an employee who was becoming blind. The individual enrolled in a computer training sequence and successfully completed the course; as a result, another blind programmer was subsequently hired (Tate, 1975). An MIT Braillemboss terminal was purchased in 1971 for online capabilities. The project was deemed successful for the programmers and for the corporation.

The Honeywell Corporation cooperated with the Arkansas Enterprises for the Blind at Little Rock to train blind programmers (Technological Horizons in Education, 1980). The vocational rehabilitation program was initiated in 1972, with braille terminals and voice synthesizers providing output. Students were self-paced for instruction. The qualifications for entry to the program included a background in mathematics, typing skills, spelling, and good independent travel skills. On an aptitude instrument, blind programming candidates were normed with scores of sighted candidates (Technological Horizons in Education, 1980, p. 43).

Computer literacy has been an issue discussed in the literature for nonhandicapped individuals as well as for handicapped individuals. Ryan and Bedi (1978) described a workshop program designed to promote computer literacy with visually handicapped students. The workshops were held in New York during the summer of 1977. The authors observed that

> the ability of visually handicapped people to become successful computer programmers has been repeatedly demonstrated. Much of the developmental work in designing braille translation software, voice synthesis, and specialized hardware has been accomplished by visually impaired professionals. (Ryan & Bedi, 1978, p. 303)

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> the ability of visually handicapped people [illegible] computer environments has been especially [illegible] the developmental work in designing [illegible] ware, voice synthesis, and specialized hardware has [illegible] accomplished by visually impaired professionals. ([illegible] 1976, p. 303)

The workshop was conducted to help blind youths begin to understand computers and the potential for careers with computer programming. The authors cited a lack of training provisions in public education and in higher education for blind persons interested in programming. The workshop sessions were considered valuable for the trainees.

The Royal National College in Great Britain has established a computer training program for visually handicapped students which emphasizes the use of microcomputers for word processing and for basic computer programming. "The partially-sighted were able to manage the input and editing functions of the word processor after a term of two lecture periods a week" (Talbot, 1982, p. 66). Alternate forms of output have been explored for the blind students, such as braille-link and the "IBM talking terminal" (Talbot, 1982, p. 66).

Final Considerations

With the capabilities of the stand-alone microcomputer units, computer assisted instruction can be a reality for most school systems in the near future. Students will have to be "computer literate." Many will find careers in the area of computer programming. "Handicapped students graduating from high school must have 'basic computer literacy'" (Watson, 1979, p. 679). Teacher time will be saved for more individualized student attention with the microcomputer technology in classrooms (Gleason, 1981, p. 16). Special educators will need to both make use of the technology to benefit students and be able to help with student instruction in the use of microcomputers. Teachers will need to be literate before they can expect students to become knowledgeable (Stallard, 1982). The applications for microcomputers extend far beyond computer assisted instruction. Microcomputers can be used for planning,

for IEP preparation, for supplementary as well as actual instruction, for administrative purposes like grading, and for related services, like communication prostheses (Bennett, 1982). Special educators need to ensure that handicapped pupils have access to the technology equal to, if not more than nonhandicapped peers. Unless educators take an active role in identification and development of necessary adaptations, the visually handicapped could be the last to benefit from the advances in the technology.

CHAPTER III

METHOD

Ethnographic Research Methodology

Ethnographic research methodology has been a primary methodology in social sciences research for hundreds of years. The methodology relies on information collection from participant observation, informant interviewing, and the study of objects and documents (artifacts) of a culture or group. Specific methodological procedures have not been established as universally applicable to all ethnographic studies. "Anthropologists do not themselves have a unified conception of ethnography" (Hymes, 1978, p. 1). There are, nonetheless, certain techniques and characteristics unique to the methodology which make ethnography suitable for studying human behavior in a variety of environments.

Babbie (1975) noted that social research studies are done for distinct purposes. He has cited three specific reasons for conducting field research, or ethnographic research. First, studies may be exploratory.

> Exploratory studies are most typically done for three purposes: (1) simply to satisfy the researcher's curiosity and desire for better understanding, (2) to test the feasibility of undertaking a more careful study, and (3) to develop the methods to be employed in a more careful study. . . . Exploratory studies are very valuable in social scientific research. They are essential whenever a researcher is breaking new ground, and they can almost always yield new insights into a topic for research. (p. 50)

A second purpose, descriptive research, attempts to narrate the incidents and settings of a culture or environment. This kind of research would also describe human interactions. Finally, explanations may be a purpose of social science research, carrying description one step further. In this kind of study, the researcher would not only describe, but interpret or explain the importance of human behaviors and interactions (Babbie, 1975, p. 51).

Ethnography, or field work, requires the researcher to identify a field in which to conduct the study. It may be an entire culture or a subculture of a larger group. Regardless of the nature of the field studied, research is done in natural settings. "Participant observation and ecological observation stress the importance of natural settings" (LaFrance, 1981, p. 280). The researcher who is observing in a natural setting has the obligation to come into the setting with little disruption of the incidents or interactions which might occur. "Naturalistic methods call for as little investigator intervention as possible into the field of study" (p. 264).

The ethnographer must become sufficiently involved in the setting to be empathetic, but not so involved that objectivity is lost. Bruyn (1973) believed that objectivity was definitely possible for the ethnographer, with respect for the subjects of the study maintained as well. He felt that accuracy and lack of prejudice would be critical characteristics of a good social science researcher (Bruyn, 1973, p. 231). Everhart (1977) and others (Sanday, 1979; Wolcott, 1970) have cautioned social science researchers about maintaining objectivity when intensely involved in a cultural setting. The problem is "being a part of the society being studied and, at the same time, retaining a

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perspective from the outside" (Everhart, 1977, p. 1). Researchers may have a tendency to become too close if they are "going native" (Everhart, 1977, p. 11), becoming actual members of the group under investigation. Some examples of "going native" would include a teacher who studies his or her own classroom as a field project, or a researcher who joins a club or group to study the organizational interactions and environment. Objectivity would be lost more easily when the researcher is excessively empathetic to a group. More often, fieldworkers are strictly observers in the research setting (Everhart, 1977, p. 3). Participant observation then becomes the major source of data for the study, and the researcher attempts to maintain objectivity, cultivating "disciplined subjectivity" (Wilson, 1977, p. 258) by not becoming so involved with the human interactions in a setting that investigative effectiveness is lost.

Participant Observation

Participant observation is vital to field work. The researcher must involve himself or herself with the culture being studied to develop an accurate picture of the culture.

> In the search for meaning and understanding in human relationships, a significant number of sociologists in the classical tradition, as well as in contemporary research, have recognized the importance of participant observation in methodology. (Bruyn, 1973, p. 224)

Sanday (1979) has concurred that participant observation is "central (p. 527) to ethnography. Participant observation provides the researcher with

> a rich experiential context which causes him to become aware of incongruous or unexplained facts, makes him sensitive to their possible implications and connections with other observed facts, and thus pushes him continually to revise and adapt his theoretical orientation and specific problems in the direction

> of greater relevance to the phenomena under study. (Becker & Geer, 1957, p. 32)

A great deal of information about a culture may be obtained through observation of the culture. With participant observation, "one can observe actual changes in behavior over a period of time and note the events which precede and follow them" (Becker & Geer, 1973, p. 32). Investigating over time allows the observer to identify "cause-and-effect relationships" (Davis & Heyl, 1980, p. 13).

Bruyn (1973) has noted that "all scientific research involves the conceptualization of data" (p. 230). The nature of the data can change the conceptualization. Participant observation involves a different conceptualization than with a statistical research design. Observation over time provides detailed fieldnotes which can be recorded in narrative form; interviews which have been taped generate transcriptions of dialogues. These kinds of data are not measurements expressed numerically from a single point in time. Observation data are analyzed differently than statistical data.

> The ethnographer's task is the selective recording of human behavior in order to construct explanations of that behavior in cultural terms. The standard ethnography thus provides an account of the way of life of some special human process . . . or some particular group of people. (Wolcott, 1970, p. 115)

The methodology requires that the researcher become an astute observer and objective recorder of the situations and interactions which he or she observes. "Fieldworkers learn to use themselves as the principal and most reliable instrument of observation, selection, coordination, and interpretation" (Sanday, 1979, p. 528).

Wilson (1977) has noted some of the advantages of participant observation.

> The participant observer has . . . latitude in that he is not limited to prespecified places and times. He can interview and observe in many situations not usually available to other researchers. He also has an advantage in his ability to monitor the rapport he has built with interviewees and to gain access to confidential information. (Wilson, 1977, p. 256)

To begin a field study involving participant observation, the researcher must first go through the entry process (Everhart, 1977). Contacts must be made with key individuals in the setting, to gain admittance into the setting. Sometimes, the entry process is long and requires many steps before the participant observer is actually able to begin the fieldwork. The role of the researcher must be defined to the authorities in the setting. The "most common practice is for the field-worker to serve as an observer" (Everhart, 1977, p. 3). Rapport must be built during the entry into the field setting before analyzing is done (Bruyn, 1973). The researcher enters with the intent of taking from the setting, of investigating individuals and the whole group. He or she must be prepared to give back something of himself or herself; Everhart (1977) refers to the concept as "reciprocity" (p. 9). Giving something in return gains credibility for the researcher, whether the giving involves providing refreshments for a party or simply visiting with one of the interviewees on a personal level, without asking research-related questions.

The fieldworker must also be sensitive to the time when the fieldwork has been exhausted. "Receptivity" (p. 13) is the term Ever-hart has given to the researcher's understanding that his or her role in the field has reached completion, and that fieldwork should be terminated. More time in the field might not add to the study, and might additionally cause the fieldworker to become overly involved with

the people being studied. The fieldworker might then experience pressure to reveal more of himself or herself. Objectivity would be in jeopardy. "The role of the stranger is viable for a relatively short period of time. Perhaps then there is some justification for the usual 'short term' fieldwork period (six to nine months)" (Everhart, 1977, p. 13). Researchers who have overextended field observation time become fatigued and forget to note details or overlook important incidents because of familiarity.

Once into the setting, "the participant observer records, interprets and explains social phenomena" (Bruyn, 1973, p. 230). The researcher seeks to become further involved with the individuals of the setting by learning

> the formal and informal . . . schedules and geographies of the participants. He must become aware of all the behavior settings in the community and their important characteristics. He works to become part of the various communication networks that daily orient participants about where and when significant events are likely to occur. (Wilson, 1977, p. 256)

Participant observation over time permits the researcher to see the events as they happen in a setting, to record occurrences and interactions as accurately as possible, and to draw conclusions about the information he or she has gathered. The result is a picture of the setting and the interactions of individuals in the setting with behaviors which show change over time.

Interviewing and Artifact Study

Triangulation of data, the use of multiple methods or sources for data gathering, allows the researcher to substantiate and confirm information (Denzin, 1970).

> Triangulation does more than provide crucial checks on the validity of the data; it facilitates the pursuit of data with which to

the people being studied. The fieldwo[illegible]

sure to reveal some of [illegible]

[illegible]

Interview[illegible]

Triangulation of data, [illegible]

data gathering, allows the researcher to [illegible]

information (Denzin, 1970).

> Triangulation does more than provide crucial checks on the validity of the data; it facilitates the pursuit of data with which to

> identify contradictions, fill gaps, clarify continuities or sudden changes, or to show cause-and-effect relationships. (Davis & Heyl, 1980, p. 13)

Several types of data triangulation are possible. Data may be gathered in terms of "(1) time, (2) space, (3) person, and these levels (1) aggregate (person), (2) interactive (person), (3) collectivity (person)" (Denzin, 1970, p. 301). "A major focus in time observations will be its relationship to ongoing interactions; observers can sample activities by time of day, week, month, or year" (Denzin, 1970, p. 302). Space can be sampled for individuals or for groups, for example, the different components of an entire setting can be observed. Person analysis has three levels. Aggregate analysis studies individuals as separate entities within the aggregate society. Interactive analysis studies small organizational structures of people, like "families, small groups, and work crews" (Denzin, 1970, p. 302). Collective analysis deals with organizations as the units of observation (Denzin, 1970, p. 302). For the present study, aggretage analysis and interactive analysis were used rather than collective analysis.

Participant observation allows the researcher to get ideas about settings which are being investigated. Interviewing adds information from the viewpoints of individuals being observed. Wilson (1977) has noted that it is also vital for the researcher to decide whom to interview. The individuals who provide the most information in informal or formal interviews become key informants for the researcher. Observations and ideas can be confirmed for meaning with interviewing. Becker and Geer (1957) have observed that while "participant observation gives firsthand information on incidents . . . interviewing gives secondhand information" (p. 28). Wolcott (1970) has stressed the importance of interviewing

people in the research setting for information about institutional characteristics and organization, whether formal or informal (p. 116). The perceptions of closely involved persons often give the researcher new insights on the setting and interactions or incidents which have been observed. "Decisions about who is talked to are made in terms of emerging theory and previously gathered information" (Wilson, 1977, p. 256). As the researcher gathers information and notes patterns which seem to be consistent, certain individuals may be identified to provide information which will clarify ideas for the researcher.

The study of documents of the setting may also provide affirming information or give new insights for further investigation. Both documents and objects used in a setting for special purposes will have some social importance; these "artifacts" (Spradley, 1980) should not be overlooked by the researcher.

Reliability and Validity

"The value of scientific research is partially dependent on the ability of individual researchers to demonstrate the credibility of their findings" (LeCompte & Goetz, 1982, p. 31). Qualitative research has been questioned in relation to reliability and validity.

Research serves a variety of purposes. Studies may be conducted to describe phenomena or to explain phenomena. "The choice of a paradigm should be made on the basis of how closely the underlying assumptions of the paradigm fit the reality of the situation being investigated" (Jefferson, 1981, p. 5). Qualitative research in naturalistic settings lends itself to some research problems more appropriately than quantitative research does. Qualitative research is often characterized by an "interest in discovery rather than verification" (Jefferson, 1981, p. 6) and "use

of the inquirer as the basic instrumentation rather than other kinds of more quantitative measures" (Jefferson, 1981, p. 6). Qualitative research enables the researcher to document the process of change in individuals or in group interactions over time. The researcher participates over time and systematically records data to provide the basis for description and documentation of change. This kind of research has different concerns for reliability and validity than does quantitative research.

> To ensure internal validity it is necessary to confirm findings with respondents through a series of perception checks. Furthermore, before findings can be generalized to another context it is necessary that conditions in the two contexts be similar. A comprehensive transcript of all observations (thick description) can serve as the basis for such a comparison. Reliability in quantitative research . . . becomes dependability in qualitative research because variance is not "written off" as error as it is in rationalistic inquiry. Still, variability needs to be tracked or traced (via thick description) in order to determine the nature of this error. Finally, objectivity in quantitative studies becomes confirmability of the findings, the study requires each of the following to be evident: prolonged time at the site; persistent observation; . . . triangulation; and thick description, which provides an audit trail. Thick description means the collection of enough information so that the possible transferability to other contexts might be contemplated. (Jefferson, 1981, p. 6)

Reliability requires that studies can be replicated with similar results. While naturally occurring incidents and situations cannot necessarily be duplicated for researchers to observe, similar characteristics of settings and of human behavior can generate similar identifiable patterns. For example, a low vision student in a high school in a rural area may be expected to have some behaviors in common with a low vision student in a high school from a different rural area.

Ethnographic research is primarily concerned with the events which occur and not with experimental variables. With observation of settings

through time, information is gathered to fully document the process of change, rather than investigating change from one discrete point in time to a second point in time. Because the ethnographer attempts to describe human behavior in cultural terms, observed maturation would offer good qualitative information. The observer attempts to cause minimal disruption in the natural setting, but nonetheless will influence it with his or her presence. Human behavior is subject to constraints which will supercede the influence of the observer eventually (Becker, 1970, p. 43). The teacher has primary influence on pupils in a classroom. The initial interest in an observer, or concern about the observer's presence, is minimized by the teacher's authority over the pupils. In the present study observers from the local university are daily phenomena and would hardly generate much interest among the students.

Long term field work may diminish the observer's identification of important incidents and reporting of such incidents (Wolcott, 1970). The present study involved a period of time sufficient to gather substantiating data, but not so long that effectiveness was diminished.

Systematic and objective observation, recording, and analyzing of data are vital factors for reliability and validity in qualitative research. The researcher must take steps to ensure that others coming into the setting for investigative purposes would encounter similar patterns and findings. The observations chosen by the researcher must be relevant to the research questions and the hypotheses which are eventually generated. Individuals interviewed must be key informants. The observations and the individuals interviewed can change the nature of the findings. In the present study, observations were conducted in all of Rob's classes over several months and significant individuals in Rob's

environment were interviewed. Rob's parents, his physician and ophthalmologist, his teachers, and Rob himself were interviewed. Questions revolved around the original research questions; similar questions were asked of each group of informants. For example, all teachers were asked about their perceptions of Rob's progress for their classes. Teachers were also asked about Rob's use of the microcomputer for completion of classwork. These questions were directly related to the original research questions for the study. Additional observations were conducted in Rob's home and the microcomputer labs at the high school and the university because such observations were deemed to contribute useful information to observed phenomena in Rob's educational process and microcomputer experiences.

Exploratory studies may describe; such studies generate new concepts or hypotheses for future research. Internal validity is less a concern, because the hypotheses generated are subject to further verification. The researcher in the present study attempted to observe and record data systematically, define coding variables, arrange and code data in such a way that the focus of the study was directly generated from the research questions. The researcher sought to generate hypotheses from the study which would be useful for further research on the topic of microcomputer utilization with low vision pupils.

Ethnography in Educational Settings

Participant observation, interviewing, and studying the artifacts of a culture or setting provide the fieldworker with an overall picture of the culture. "The ethnographer who becomes immersed in other people's realities is never quite the same afterward" (Sanday, 1979, p. 527).

The researcher becomes very aware of the characteristics, behaviors, and meanings inherent to another culture or setting than that to which he or she is accustomed.

Wolcott (1970) observed that the methodology could be beneficial in educational settings. "A small but growing body of literature gives indication that more attention is being given to anthropologically-oriented field studies in education" (p. 120). Wolcott (1970) studied the role of the principal using the methodology, and noted that most of the available literature does not truly explain what principals do.

> Unfortunately, the literature in educational administration is disappointing as a source of data for learning about the real world of the principal, since it tends to be hortatory or normative in content. . . . It is prescriptive rather than descriptive. (Wolcott, 1970, p. 115)

The kinds of research being done in education presently often rely on questionnaires, which prompt socially acceptable answers. Ethnography allows the researcher to rely on firsthand observation, rather than depend on such instruments, which may be misinterpreted by individuals completing them. Wolcott (1970) cautioned that

> the researcher who adopts this approach must face the problems common to participant observation in any setting, especially including a confrontation with oneself as a research instrument. In educational settings, a researcher contemplating the ethnographic approach faces certain rather unique problems as well, for he undertakes not only a cross-cultural and comparative approach to studying events, but he must also attempt the difficult task of suddenly assuming the role of formal observer within an institutional framework with which he has probably been in continuous contact since the age of six. (p. 121).

Wilson (1977) also noted the increasing interest in educational research done with social scientific methodology. Deno (1980) and Barton and Brulle (1981) advocated the use of naturalistic observation for working with behaviors of exceptional children in classrooms. These

The researcher becomes very aware of the [illegible]

meanings [illegible] to [illegible]

and [illegible]

[illegible]

[illegible]

Wilson (1977) also noted that [illegible]

research done with social scientific methodology. [illegible]

and Grills (1981) advocated the use of naturalistic observation for

working with behaviors of exceptional children in classrooms. These

writers believe that educational research can be expanded by the use of the methodology.

Role of the Researcher for the Present Study

Ethnographic researchers must define their roles as part of research reporting.

> To the degree that the fieldworker is able to understand and document his own role in a social setting, then we all stand to gain a more realistic account of that setting as well as a documentary of the process of doing fieldwork in educational settings. (Everhart, 1977, p. 14)

For the reader of social science research, knowing exactly how the investigator fit into the setting or culture is important. The researcher's definitive role shapes the viewpoint of the study. For example, this researcher taught visually handicapped pupils for six years in a resource setting. Because of the experience, entry to the research setting was facilitated. Some understandings of low vision pupils and their behaviors made this researcher a less naive observer initially. While more naive observers might have concluded that Robert was inattentive when he watched the floor or his desk, this observer perceived that he was indeed listening. Additionally, observers mature and become more sensitive to the incidents which are observed and the interactions taking place. The maturation enhances the researcher's ability to gather data and interpret data accurately.

Bruyn (1973) also has advocated the researcher's obligation to define his or her "own status in the social system" (p. 232). The degree to which the researcher has been accepted and become integrated into the setting will determine the amount and quality of information which can be gathered.

Everhart (1977) has noted that in his research, he has been "careful to remain a stranger, rarely offering my opinion, and replying to questions as blandly as possible" (p. 4). But as an ethnographer, the researcher may present himself or herself to those individuals within the setting as he or she wishes to be identified.

Many settings naturally dictate the role which the researcher must assume. "The researcher acquires a social role which is determined by the requirements of the research design and the framework of the culture" (Bruyn, 1973, p. 225). For example, this researcher studied the special education mainstreaming process in an all-black school which was located in a large metropolitan area (Marquis, 1982). The study was conducted for four months, from January, 1982 to May, 1982. The role which seemed most appropriate initially involved strict observation in most classes where special education pupils were mainstreamed. Eventually, the role was expanded in lower grade classes (second and third grades) to allow the researcher to teach sign language to the pupils and bring her husband to meet the pupils. These two participant activities seemed necessary for reciprocity, and permitted the researcher to have greater access to regular classroom observations. While this researcher's role was defined from the beginning of the project by friendship with the principal, during the course of the study relationships with several of the teachers, with the secretary, and with some of the school workers were developed. These relationships served to permit the researcher to freely circulate within the school and interview teachers without their fearing that information would go straight back to the principal.

Sanday (1979) has noted that "one of the most important criteria in the past has been prior experience in another's culture" (p. 528)

for conducting ethnographic research in one's own culture or environment. This would especially be true in educational research. Exposure to something different than what the researcher has experienced would enhance attention to detail which might be overlooked due to the researcher's familiarity with certain educational settings. This researcher's study in a metropolitan educational setting which was distinctly different from the more rural settings in which she had taught and participated gave insights and preparation to return to the familiar setting. The familiar can generate the loss of objectivity, and while empathy is necessary, "one must also be able to record, categorize, and code what is being observed" (Sanday, 1979, p. 528).

The present study was done in a high school with which the researcher has been associated for several years. The researcher has worked with many of the teachers who were central to the study. Robert, the subject of the study, was a pupil of the researcher for six years. During the past three years, the researcher has dropped that role and concentrated on university work, having almost no contact with many of the teachers in the high school. Some contact with the subject and his family was maintained, but on a sporadic basis. The researcher was familiar with the geographic characteristics of the high school and with basic scheduling of students.

Permission to conduct the research study was sought in the summer of 1982 through the appropriate university administrative channels. The subject's parents permitted contacts during the summer before the formal school observations began. The entry process was not difficult because of the school's commitment to research. The researcher's contacts with

individuals in the administrative process alleviated some of the problems with entry that might be anticipated in other settings.

Once formal permission was granted, the researcher sent a note to the subject's teachers. All teachers were informed of the project and were asked to respond in terms of the best day and time for observations to begin. Because of the university association, observers in the setting are a daily occurrence. Teachers all responded positively and indicated that no appointments were necessary to make observations.

The first school contacts were strictly observations except for those in the special physical education class, where the teacher interacted immediately with the researcher. The contacts in previous years had involved our teaching the physical education class on a team basis and one of the teacher's first comments was that the researcher needed tennis shoes to participate. Later in the course of field observations, more personal contacts and interactions with the teachers were noted.

Home observations were much more informal, with the researcher interacting with Rob, his brother, and both parents. Frequent telephone calls and informal interviews with the parents provided information as well.

Rob seemed to be very comfortable with the researcher's presence. He often talked to the researcher before or after classes and on more than one occasion suggested observations to the researcher which might be beneficial. When Rob was to give a report in his consumer economics class, he made a point of telling the researcher when the report was planned, so that she could observe it. Rob also invited the researcher to come to the school library during his free time to observe him working

with a younger student on the microcomputer. Speaking to the researcher did not seem to bother Rob, even though it meant that classmates might identify who was being observed.

Because of the length of time since this researcher had actually worked with Rob (four years), many changes were evident. The informal interaction with Rob and with his teachers provided a great deal of confirming information for the study.

Procedure

The research design for the study was a single subject case study, using ethnographic techniques. When the field was identified and permission to make the study granted, the researcher began field observations. One observation was made in July, 1982. The observations in the high school were begun in September, 1982 and were concluded in January, 1983. All data gathering was concluded by the end of February, 1983. The fieldwork spanned a period of eight months.

Observations or other contacts were conducted several hours weekly when possible. Making observations was sometimes a problem due to Rob's excessive absences (see Appendix A for schedule of field observations, interviews, and other contacts). Regular academic classes were observed more often than special education classes (a study skills class and the physical education class). Fieldnotes were made in a stenographic notebook and fully transcribed daily or weekly into a word processing program on a microcomputer. The data files were arranged into fifty-two reports. Most of the reports were of single observations, interviews, or contacts, but occasionally a contact was noted within another report if the contact was brief (e.g., when the researcher was unable to observe on a given day

due to Rob's absence). The fifty-two reports were treated separately for pagination purposes. Each report began with a cover sheet as the first page; the remainder of the pages for each report were paginated consecutively. Page references for the fieldnotes cite the report number first, followed by a hyphen and finally the page number within the report on which a citation may be found. For example, a citation for the interview with Rob's father in Report 19 would be the following: Marquis, 1983, p. 19-4. This indicates that the reader is directed to Report 19, page 4 of the unpublished fieldnotes document. The average number of pages for each report was 7.5.

During the course of the data transcription, certain themes seemed to emerge which were consistently occurring. In consultation with a methodological advisor, the researcher developed an index of items for analyzing observed behaviors (see Appendix B).

A total of 390 pages of the final fieldnotes document were coded according to twenty-two major variables and the subvariables of each major variable. Entries were made into the document margin to indicate exactly which observed behaviors represented variable items. Quotes were extracted from the text to substantiate the major themes which were identified for the data analysis.

A coding worksheet booklet was assembled; all coded data were transferred to the booklet using notation in the pagination format described earlier. Frequencies of the variables were studied and interpreted for importance. The report was written with the frequency counts providing substantiation of the observed behaviors which related to the initial research questions for the study.

CHAPTER IV

ANALYSIS OF DATA

Introduction: The Case Study

Subject

Robert (Rob). Rob was a senior in high school. During the time the data were gathered he was seventeen years old. He had attended affiliated schools for nine and a half years. His primary handicap was low vision. The condition had been noted in first grade, according to school records, after routine vision screening (Marquis, 1983, p. 52-11). Earlier in his life, Rob's primary handicap had been Juvenile Rheumatoid Arthritis (JFA). In an interview with Rob's physician, it was noted that the JRA had diminished.

> Marquis: Do you . . . see Rob's medical condition, the one you basically see . . . in him. . . the JRA, limiting him in any way? Would you perceive that to limit?
>
> Dr. Hanner: Generally speaking, for rheumatoid arthritis, juvenile rheumatoid arthritis tends to kind of burn itself out as people become adults. And, this has actually been the case with Rob, that Rob's arthritis problem is much less of a problem than it had been earlier. He has very minimal problems as far as his knees, which is the primary target organ for his rheumatoid arthritis. (Marquis, 1983, p. 29-4)

Rob received physical therapy twice weekly for the arthritis. He also attended a special physical education class, both for the physical disability and for the vision problem, so he would not have bodily contact or undue ocular strain with physical education activities.

Rob had changed physically since the time he was my student (1973 to 1979). By his senior year, he had grown a great deal. I

described him in the fieldnotes as he took a test in Geometry class one day.

> I had not previously noticed if Rob appeared any different from any of the others; I had not thought about comparing him to classmates. He seems always to have on the "uniform," blue jeans, suede sneakers, and a plaid shirt. Today he also had on a light blue velour v-neck sweater. Rob has had a curly permanent for some months now, which not many of the students had, but he did not look out of place with it. Like many of the others, he wore white tube socks with stripes. Apart from his thick glasses, it would be difficult to pick him out as impaired or different. Rob also carried a backpack, as did several of the others. Rob is tall, about six feet or even more, and quite thin. When he walked, he shuffled and walked fairly slowly, always watching. (Marquis, 1983, p. 20-4)

Rob gave every appearance of being a typical teenager. Each time that I observed, he wore the same kind of outfit and always had the backpack at school.

Family. Rob's father, Ken, worked with computers in the corporate headquarters of a large business located in Rob's home community. Rob's mother, Laura, had worked for several years outside of the home in real estate and in a large store designing displays. She has a great deal of artistic talent and often paints. Earlier in his life, Rob had also been interested in art but his mother noted that he had lost that interest somewhat, due to lack of confidence in his ability and the visual problems (Marquis, 1983, pp. 18-3; 18-4). Rob's mother also programmed for the microcomputer, sometimes writing programs for business and agencies. Both parents are young, still in their thirties. Rob is the older child. His brother, Todd, is three and a half years younger. He was a student in the junior high school in their home community.

Rob's family is very close. He often plays with his brother or works with Todd on the microcomputer (Marquis, 1983, pp. 17-3; 18-4). During one observation in their home, I noted that Todd came in and sat

on Rob's lap at the microcomputer. Rob did not seem to mind a great deal, remarking only "this is fun having him on my lap . . . this kills me!" (Marquis, 1983, p. 17-3). Laura later said that the boys are very compatible. Only when Rob worried about his vision did he show irritation with his brother. According to Laura, this was because his brother was less likely than the parents to snap back (Marquis, 1983, p. 18-3).

Rob's parents are very supportive of both of the boys. Rob required more time in relation to his educational program and medical problems. Both physicians commented on the parents being present at examinations and being fully aware of the medical prognoses (Marquis, 1983, pp. 29-7; 41-4). The school records indicated that the parents attended parent-teacher conferences and Individualized Education Plan (IEP) staff meetings consistently (Marquis, 1983, pp. 52-3; 52-4; 52-5). From my own experience, I knew that Ken and Laura were frequent visitors to school and kept in close touch with the teachers. This seemed to be true for his senior year as well. When he had problems with low grades in classes, the resource teacher for the visually handicapped, Ms. Barton, reported that everyone was concerned (Marquis, 1983, p. 38-16). The family interactions in the home when I observed were very active, with frequent dialogues between Rob and his parents or Rob and Todd. The interactions were positive except one observed instance when Rob was experiencing some visual fluctuation (a frequent occurrence) and became irritated with his brother (Marquis, 1983, p. 17-5). Todd had moved diskette boxes and changed covers on diskettes so he could have diskette covers with "elephant" pictures on them (characteristic of one brand).

Todd: Where's my disk?

on Bob's lap at the [illegible] [illegible]. [illegible]

desk, [illegible] only [illegible] [illegible]

[illegible] [illegible], 1985 [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

criticized with the [illegible] [illegible]

[illegible] books and [illegible] covers [illegible]

covers with "elephant" pictures on them (the [illegible]

Todd: Where's my disk!

Rob: It's right . . . I put it back in its folder . . . unlike some people do to my disks.

Todd: Know what I'm gonna do? . . . I'm gonna change covers with you. [He did that as he spoke.]

Rob: DON'T change the covers, 'kay??

Todd spoke partly to himself and partly to Rob as he did that. Leaving the room, he called back to Rob.

Todd: Don't tell mommy! (Marquis, 1983, p. 17-5)

Rob was ill frequently in the first semester, which sometimes made data collection difficult. Most of the teachers interviewed commented on his illnesses, which seemed to be colds. During the second semester he also spent more than one week out of school but only one full week during the data collection period.

Setting

Home. Rob's family lived in a three bedroom ranch-style home on the east side of the community. They had lived in the house for about eight years. The neighborhood was densely populated. Many of the neighboring families had youngsters.

Community and School. Rob attended a small secondary school of about 500 students in a farming community of 35,000 to 40,000 people. The high school provided a standard four-year program. A program for low incidence handicapped students was housed in the high school and the nearby elementary school. Both were associated with a local university of about 20,000 students. Clinical experiences for teacher training were conducted in the two schools on a daily basis. Rob attended public elementary school until third grade, when it was determined that he needed special services on a consistent basis. He then entered the elementary school at the university.

Rob's home was in a nearby community, one slightly larger than the community in which the high school was located. Several major businesses and industries operated in Rob's home community. The local school district transported special education students to the high school and the grade school daily.

Rob's School Schedule. During the first semester, Rob had four regular education classes and two classes in the special education program. He started the day with English at 8:00 a.m. At 9:00, Rob went to special physical education class, and at 10:00 he had Study Skills with the resource teacher for the visually handicapped, Ms. Barton. Chemistry was at 11:00, Consumer Ecomomics at 12:00, and Geometry was at 1:00. The Consumer Economics class changed teachers and rooms at the end of the first quarter (nine weeks). Some of the classes changed for second semester. Geometry was at 8:00, with a different group of classmates. Special physical education and Chemistry remained the same. Two new regular classes were added, World History at 10:00 and Mass Communications at 1:00. English was dropped, as was Consumer Economics. The special Education study skills class was dropped. At 2:00 p.m. during the first semester, Rob spent his free time with Greg in the library at the microcomputer. During second semester, Rob also had free time (at 12:00 and at 2:00 again) but did not spend it with Greg because of schedule conflicts.

Findings

Several major concepts were addressed in the original research questions. The initial core of the study comprised behavioral evidence of Rob's use of the microcomputer to complete homework, his interactions

with peers and teachers, and the overall impact of microcomputer usage on his educational experiences. During the data collection process, and item index (see Appendix B) was constructed as emerging patterns of behavior were noted. The findings are reported from the analysis of data which involved coding all of the data using the 22 original variables with three to seven variables for each item. Six additional minor variables were developed after behavioral evidence was identified in the field reports. The item index included variables to address the research questions and variables to analyze related concepts. The data analysis which follows reports the results of the coding done using the item index variables.

Visual Functioning

As the study proceeded, it became evident that visual functioning was a key element in Rob's ability to use the microcomputer. Several patterns of visual use were observed. Items 10, 11, and 12 were developed to account for the range of visual use behaviors observed. Items 10 and 11 were concerned with Rob's ability to read print materials in several forms (regular, fine, enlarged, microcomputer monitor characters and chalkboard). Item 12 contained subvariables relevant to "other visual functioning," including travel vision, locating and tracking people or objects, and positioning for use of residual vision. Information was substantiated by interviews with the ophthalmologist and with parents and teachers.

Explanation of the Visual Condition. Dr. Walker, the ophthalmologist, explained Rob's visual condition as a syndrome (set of related symptoms). He noted that the symptom complex is called "Still's disease" (Marquis, 1983, p. 41-2). It is characterized by childhood uveitis, an "inflammatory

with peers and teachers; and the overall [illegible] on his educational experiences [illegible] free index (see Appendix [illegible]) [illegible] behavior were [illegible] [illegible]

[illegible]

and teachers.

Explanation of the Visual Condition. Dr. [illegible], the [illegible] explained Bob's visual condition as a syndrome (set of related symptoms). He noted that the symptom complex is called "Still's disease" ([illegible], 1959, p. 41-47). It is characterized by childhood arthritis, an "inflammatory

disease of the pigmented portion of the eye, including the iris and the choroid, which then is accompanied frequently by cataract formation and glaucoma" (Marquis, 1983, p. 41-2). In Rob's case, the vision of the right eye was lost following cataract surgery, and a total enucleation (removal) of the eye had to be done several years later. The left eye was also operated on for cataract and vision was retained, but glaucoma is present. Rob has been experiencing pressure fluctuations for several years. With rising pressure, either surgical procedure or medication has been used. At the time of the study, the pressure was not stable. In January, 1983 Rob missed several days of school due to problems with the pressure elevation. The prognosis is not necessarily good for retention of the residual vision, and Dr. Walker indicated that Rob is fully aware of all the possibilities and alternatives for keeping the pressure under control (Marquis, 1983, p. 41-5). Pressure elevations cause Rob to experience pain and make reading and other visual activity uncomfortable and difficult.

Use of Vision for Reading. During twelve hours of observation, sixteen recorded notations indicated that Rob read regular print (black on white). During one Consumer Economics class, Rob read aloud from the print book as did his classmates. He read steadily and at an appropriate speed from a distance of about 20 cm (Marquis, 1983, p. 26-5). In his interview, he confirmed that he could read regular print but did not like to do so. He also said that on occasion he could not read some standard types of print (Marquis, 1983, p. 51-15). Ms. Barton, the resource teacher, and the Chemistry teacher indicated that he could read regular print (Marquis, 1983, pp. 31-5; 38-14). Ken noted that Rob could read regular print, but not quickly enough to be of benefit to him (Marquis, 1983,

p. 19-9); both parents indicated that regular print was not of great benefit. Rob was never observed to read fine print. During one visit in his home the week Rob's family obtained the new printer, Rob confirmed that he could not read fine print (Marquis, 1983, p. 15-7).

Rob read enlarged materials, as noted seven times in six observations. Interviews with Ms. Barton and three of the regular class teachers indicated that they felt he could read enlarged materials and should have them for testing especially (Marquis, 1983, pp. 31-5; 35-8; 38-15, 39-4). Rob himself indicated that he could read enlarged materials more readily than regular print (Marquis, 1983, pp. 18-9; 19-9).

Rob could read the video monitor on the Radio Shack TRS Model I and the TRS Model III microcomputers. The characters on the video monitor of the Radio Shack equipment are about three times as large as standard elite type characters. The distance of the reader from either the regular print page or the microcomputer monitor would influence the reader's ability to see the print. Rob read print at about 20 cm and the microcomputer monitor at about 30 to 40 cm most of the time. At home, he had a green "shield" which made the characters appear bright green (Marquis, 1983, p. 15-7). The shield was attached to the video monitor. During seven entire observation periods totalling eight hours, Rob read the microcomputer screen (Report 2 at the university microcomputer lab; Report 13 at the high school microcomputer lab; Report 14 at the high school library; Report 15 at Rob's home; Report 16 at the high school library; Report 17 at the high school library; Report 21 at the high school library). He worked with his friend, Greg, in the high school library during three observations, at home during two observations, and with Ms. Barton in the high school microcomputer lab for one observation. He

also read the screen for the entire report of the visit he and I made to the university microcomputer lab. During much of this time he read things to me and explained the meanings of programs and commands. Rob seemed to have real difficulty reading the video characters only twice. Both times he was experiencing fluctuating vision. Once was in the high school library, when he "poked" the characters to a larger size on the screen (Marquis, 1983, p. 21-2); once was at home after some absences due to an allergic reaction of some kind to car exhaust (Marquis, 1983, p. 15-4).

Dr. Walker felt that Rob's need to "poke" the microcomputer image to larger characters might be the result of "retinal fatigue" (Marquis, 1983, p. 41-7). He noted that "if there are not enough retinal cells to transmit the messages back to the brain, and they have individually been fired, they . . . require recovery time" (Marquis, 1983, p. 41-7). A plausible alternative answer would be the "crowding phenomenon" (Marquis, 1983, p. 41-7) which occurs in some low vision individuals. The problem involves the need for the low vision individual to have visual information displayed so that it is not "in a crowd" (Marquis, 1983, p. 41-7) because figure-ground perception is faulty. Dr. Walker felt that "a retinal and optic nerve transmission defect" (Marquis, 1983, p. 41-7) might be responsible. The enlargement of the characters would provide new and different stimulus material for retinal cells, which would fire off some cells and allow others to recover. Moreover, less information would be presented at once, so discrimination could be facilitated. Dr. Walker cited the work of Hubel and Weisel, researchers at Harvard University, in retinal physiology. The research might provide answers

for why the negative image might be easier for some low vision individuals to read (Marquis, 1983, p. 41-9).

Getting data on how Rob read the chalkboard was more difficult than getting information on his print reading. Rob assured me that he could read it when I asked after Geometry one day (Marquis, 1983, p. 20-4). Earlier in the semester, however, the Geometry teacher had asked if he could read the next problem solution to the class and Rob had indicated that he could not read the chalkboard (Marquis, 1983, p. 9-5). The chalkboard was central to all of the work in the Geometry class. According to the teacher, the students were to correct their papers from the board (Marquis, 1983, p. 35-6). Solutions were written on the board by students, who were offered "extra credit points" (Marquis, 1983, p. 35-10) for volunteering to go to the board. Not all of what was written on the board was reiterated verbally during any of the four observations I made in the class during either semester. Achievement in Geometry would center around an individual's ability to read the answers on the board and willingness to go to the board for participation. Rob did not often look in the direction of the chalkboard in classes; only five occurrences were observed, with four occurring in Geometry class.

<u>Other Visual Functioning</u>. Use of travel vision was seen only briefly during eight observations. Most of the observed incidents occurred when he entered or left classrooms, or travelled within his Chemistry class. Rob was observed to travel confidently only twice during one of the observations, but to be cautious in travel at some time during all eight observations. Most of the time he watched and walked extremely slowly, shuffling his feet, as mentioned earlier.

Rob used residual vision to locate people or objects more often than he used vision to track or follow people or objects. Eight instances of the former were noted as opposed to only three of the latter. Rob could locate people within a close range. No instances of locating persons or objects at a distance were noted in the observations. Depending on the extent of fluctuations in visual functioning, Rob could even bend over and locate small items such as pens. However, when visual functioning was particularly poor, he could not locate some items well. He was annoyed when his box of diskettes seemed to have disappeared.

> Rob: Where's the . . . where's the . . . my . . . box? . . . wish people would quit goofin' around with my box!
>
> Marquis: I don't have it! Don't look at me!
>
> Laura (mother): What're you missing?
>
> Rob: My box!
>
> Laura: WHAT're you missing?
>
> Rob: My box! My box with the disks!
>
> Laura: Your box! Your box is right there! Right in front of you.
>
> Rob: That's why I couldn't find it, it was right in front of me. [Rob's tone of voice indicated that he was being humorous in a dry manner.] (Marquis, 1983, p. 17-7)

The same evening, Laura questioned why the screen was so fuzzy; he had not adjusted the monitor controls. He was having difficulty and perhaps was not really reading the monitor. Rob had difficulty reading the monitor to locate mistakes in program commands in only two brief observed instances during the entire seven months of the observation period.

In all classes except Chemistry, Rob sat in the front or near the teacher. In Chemistry, he sat with Frank, a friend from grade school days. In most observed instances, Rob was positioned appropriately for the use of functional vision in his left eye. In a few instances, he was positioned so that his functional vision was not useful for class participation. For example, in physical education class one day, he was positioned at the far left side of the court. Since his useful vision was in the left eye and everything to his right constituted his "blind" side, Rob would need to turn his whole body to see any teammates except the one directly in front of him. Tracking the blue balloon-ball would be difficult also, without turning to his side. Had he been positioned exactly opposite of this, all teammates and the net would have been on the side of his functional vision. In physical education, such positioning might have been made deliberately so that some of the nonambulatory students would have a more equal opportunity to hit the ball. The nonambulatory students moved a great deal more slowly than the visually handicapped students and might not have kept up with the visually handicapped players.

In Geometry, especially second semester, the same kind of positioning was evident. Because Rob was seated in the front row, visual contact with classmates was difficult without his turning around more than ninety degrees in his seat. Interaction with peers would be hampered by the positioning. In Mass Communications class during the second term, Rob also was positioned so that eye contact with classmates was cut off, however, the teacher was on his functional side.

Adaptations. As early as 1972, special education personnel from the local district and county special education program requested Large

In all classes except [illegible]

teacher. In Chemistry, he [illegible]

days. In math [illegible]

[illegible]

term, Rob also was positioned so that [illegible]

cut off, however, the teacher was on his functional side.

adaptations. As early as 1972, special education personnel from the local district and county special education program requested large

Type copies of materials for Rob to use in regular classes (Marquis, 1983, p. 52-9). Six of Rob's current teachers indicated that special adaptations for visual materials had been made. Ms. Barton, the resource teacher for the visually handicapped, stated that her role was to facilitate the adaptations so that Rob could participate in regular class activities (Marquis, 1983, p. 38-6). Ms. Barton made and/or obtained the necessary materials for Rob's regular class participation; she arranged for notetakers when needed for classes and in some instances went to the classes with Rob to get notes for him. Fourteen observed instances of special visual or physical adaptations were recorded. An example of physical adaptations would be those made in the physical education class, which was entirely adapted to meet the physical needs of the students. In a "volleyball" type of activity which was observed several times, the ball was a lightweight heavier balloon, like a beach ball. Students without much arm strength or muscular control could hit this ball more readily than they could hit a regular volleyball. The net was low with the top of the net about five feet from the ground. Students who could not hold the ball up to serve were assisted by the coach.

Extended time for completion of work on tests was not observed, although this is often true for students with visual handicaps. Ken felt that Rob would need extended time for completion of some kinds of tasks (Marquis, 1983, p. 19-8). Rob received help from the resource teacher or the aide, Mrs. Stone, in several classes. Notations of observed incidences of this kind of help were made eighteen times, primarily in English, Geometry, and Mass Communications. Adaptations were made for notetaking and reading of textual materials, but not for his work on

quizzes. Tests were enlarged or read to Rob. For some kinds of tasks, several of the teachers and Rob's father felt no adaptations were needed. For example, the Chemistry teacher felt that no adaptations were needed for the self-paced classwork. Some of the materials for the class were in print, some on tape. For English quizzes Rob did his own work.

Using the microcomputer enabled Rob to complete homework which other students would have completed by hand or with a typewriter, but no references were made by any of the teachers or Rob's parents to the concept that the microcomputer constituted an adaptation for the visual impairment. Microcomputers are used by regular students for computer science work. Rob's use of the microcomputer would not have been viewed as an adaptation, even though it was exactly that for him. To people around Rob, he was simply doing what many other high school students in the United States were doing, learning how to use microcomputers. The microcomputer provided Rob with a bridge to competition and participation in some regular education situations; it provided a medium he could see and use without seeming out of place or different from nonhandicapped students.

Effect of Visual Handicap on Performance. The perceptions of parents, regular education personnel, special education personnel, and physicians were recorded in relation to the effects of the visual and physical limitations on Rob's performance in general activities. The physical limitations imposed by the JRA syndrome, as noted earlier, were not considered great. Those limitations had diminished as the disease ameliorated, leaving Rob somewhat weak physically. The major limitation he continued to experience was due to the visual condition. Both of

quizzes. Tests were enlarged or read to him. [illegible]

several of the teachers and Rob's [illegible]

needed. For example, the [illegible]

were needed [illegible]

[illegible]

students.

[illegible]

[illegible] were [illegible] limitations on Rob's performance in [illegible] The physical limitations imposed by the JRA syndrome, as noted earlier, were not considered great. Those limitations had diminished as the illness ameliorated, leaving Rob somewhat weak physically. The major limitation he continued to experience was due to the visual condition. Both of

the physicians concurred in their feelings that Rob would be limited in performance due to the visual handicap (Marquis, 1983, pp. 21-4; 41-4; 41-5).

Laura and Ken made references to Rob's handicap seven times in the course of both interviews (Marquis, 1983, pp. 18-4; 18-9; 18-10; 19-2; 19-7). For the most part, they did not seem to feel that he was greatly handicapped. They both expressed the feeling that adaptations would help in educational settings, if nothing more than materials adaptations which would allow him access to the same materials as other students. Laura felt that he would have some adjustment problems in college but that these could be alleviated with appropriate adapted materials for coursework. Ken emphasized that the microcomputer "makes him . . . equal to the rest of the kids" (Marquis, 1983, p. 19-8). Both parents indicated their perceptions that Rob is not handicapped when computer use is considered.

Special education personnel were noted to perceive that Rob was handicapped more often than they indicated he was not handicapped. Ms. Barton felt that he could perform as nonhandicapped if the appropriate materials were available and in instances where he could use a microcomputer. The document review showed that in the perceptions of special education personnel from previous years Rob performed as handicapped for some tasks, but not for others. Often, the tasks at which he performed as nonhandicapped centered around either activities which interested him, such as Science and Social Studies, or activities for which adaptations were made.

The perceptions expressed by regular education personnel were that Rob performed as a handicapped student, with just two exceptions. The

the physicians concurred in their feelings [illegible] in performance due to the visual condition [illegible] 4; 41-5).

Laura and [illegible] causes or both [illegible] [illegible] the [illegible] handicapped [illegible] [illegible]

[illegible] mild [illegible]. The documents [illegible] special education personnel [illegible] support for some tasks, but [illegible] he performed as nonhandicapped students [illegible] interested him, such as Science and Social Studies, [illegible] which adaptations were made.

The perceptions expressed by regular education personnel were [illegible] Rob performed as a handicapped student, with just two exceptions. The

Chemistry teacher attributed Rob's performance problems to his excessive absences, not to the visual limitation (Marquis, 1983, p. 31-6). The English teacher did not feel that Rob performed as handicapped for microcomputer programming tasks (Marquis, 1983, pp. 32-4, 32-6). He even expressed respect at Rob's computer expertise, saying "someday I'M going to have to get on the good side of that" (learn how to use a microcomputer)(Marquis, 1983, p. 32-5). Apart from these exceptions, fourteen references were made by regular education personnel to Rob's visual handicap as affecting his regular class performance.

School Functioning

Class Participation. Class participation was analyzed with relation to the subvariables of item 1 on the index. Rob was considered attentive if he showed any of the first five subvariables. The sixth subvariable was "inattentive."

For the first subvariable, "watches teacher, pays attention, active" sixty-eight observed incidences were recorded over twenty-one class observations. The highest recorded number of incidences, ten, occurred in Mass Communications during the second semester. The lowest recorded number of incidences was one, which appeared in three observation reports.

The second subvariable was "asks or answers questions." Twenty-seven classes were observed for a total of twenty-four hours and forty minutes. Rob asked or answered a question in classes seventeen times. This behavior was seen ten times in seven of the regular class observations. During most regular class observations he sat quietly. Seven of the observed occurrences were for special education classes, four within one special education observation, two in another.

The third subvariable for attention in class was "watches chalkboard." Rob was observed watching the chalkboard only ten times in classes, all in regular division classes. He watched the chalkboard three times in one observation of the Geometry class. As noted earlier, he reported that he could see the chalkboard in classes, but when asked to read from it, he told the Geometry teacher he could not. Whether he was actually getting information from a chalkboard could not be established from the observations. Geometry was the only class in which the majority of the work was done from the chalkboard. Other classes did not make extensive use of the board.

"Listens, but watches floor or books" was the fourth subvariable for attention in classes. Fifty-one notations were made for the behavior during eighteen observations. Many of the notations indicated that Rob alternated looking at the floor, his books, and the teacher, in a consistent behavior sequence. In some observations it happened so often that a general notation was included in the fieldnotes without frequent confirmations. With other students, looking at the floor could mean inattention. With Rob, the opposite seemed to be true. Rob was listening and gaining information from the classwork. This conclusion was confirmed by several teachers in interviews, by Rob himself, and by his parents. Rob indicated that when he went to computer camp at another state university last summer, he used a tape recorder for his notes, as he learns more effectively when he listens. He also mentioned that he learns well in History classes through listening.

> Rob: I don't know. It's . . . I just . . . memorize the History. With Dr. Zimmerman, who's my teacher . . . it's pretty easy to take her class, 'cause when she gives a lecture, I can retain most everything that I had in there. And my notes don't have to be

The third subcategory for strategies [illegible] board." Zeb was observed [illegible] classes, all in regular [illegible] these areas is one strategy [illegible] [illegible]

[illegible]

For his notes, as he learns more effectively [illegible] mentioned that he learns well in History classes [illegible]

> Zeb: I don't know. It's . . . I [illegible] With Dr. [illegible], who's my teacher . . . [illegible] her class, 'cause when she gives a lecture, I can [illegible] everything that I had in there. And my notes don't [illegible]

real detailed, but I can remember most all of the details.

Marquis: Just from listening?

Rob: Mm-hm.

Marquis: So, if you take two or three notes, then that triggers your memory?

Rob: Yeah, 'cause I . . . History always seems to be the easiest. (Marquis, 1983, p. 51-7)

The teacher from Rob's Consumer Economics class which met the first nine weeks also confirmed his ability to appear inattentive and really be listening well.

Mrs. O'Brien: There were times when I thought he wasn't listening, and he was listening a great deal. You know, he could act like he was sleeping, and yet I could ask a question, and he could answer it. Or . . . later he could talk to me about it. . . . The only problem I had was that many times he put his head down on his arms, and literally down on the desk. And that's when I thought he was asleep. And yet, if something happened to jerk his fancy, he just reminded me of a puppy. You know, when he hears a noise, BING! the head comes up, and . . . not that he's had his hand up, but that he's listening. (Marquis, 1983, p. 40-6)

The fifth subvariable for attention in classes was "follows in book or studies if directed to do so, takes notes, works." In eighteen class observations, the notation was recorded eighty-one times. The majority of the occurrences (thirty-two) were for Chemistry, which involved self-paced work within the classroom and laboratory.

The total recorded occurences of active behaviors in classroom observations was 229 during twenty-seven observations. In Report 36, an observation of English class, a time count was recorded for twelve minutes of attention. Form 8:34 a.m. to 8:46 a.m., Rob was asked one question, responded and looked back at his books. Seven recorded notations indicated that for the majority of the time span he continued to

read detailed, but I can remember ... all ... the [illegible]

Marquis: Just from listening?

Rob: Uh-huh.

Marquis: [illegible] your [illegible]

Rob: [illegible]

[illegible]

majority of the observers [illegible]

involved [illegible] ...

The total recorded [illegible] of active [illegible]

observation was [illegible] during [illegible] observation [illegible]

an observation of English class. [illegible] the course was [illegible]

minutes of attention. From 8:15 a.m. to 8:40 a.m., [illegible]

question, responded and looked back at his books. Seven recorded [illegible]-

tions indicated that for the majority of the time span he continued to

watch his books, with exceptions of the brief interaction with the teacher and looking up at the teacher twice. The pattern seemed to be consistent from class to class and day to day. The majority of notations indicated that he watched his books or the floor, except in Chemistry, where the majority of each class was spent in individual work.

For the sixth subvariable, "inattentive," little evidence was observed. One notation was made in Report 11, when he and Frank were not really reading in Chemistry as they were supposed to be. In Report 46, an observation in Geometry class on January 13, 1983, Rob seemed inattentive for the entire period. My notations included the thought that there was not much to observe, as he had seemed statue-like throughout the period. Later, Laura and Ms. Barton both confirmed that he had been less attentive in classes early in the second semester. Rob was experiencing visual loss and pain which caused insomnia; he was nearly asleep in some of his classes. When he had stayed home one day and slept, far more active behavior was recorded for Report 48, Mass Communications class observation (January 20, 1983).

Homework Completion. Item 9 of the item index involved "completion of homework." Four of the eight teachers interviewed (English, Geometry, and two Consumer Economics teachers) spoke about Rob's failure to complete homework or parts of the assigned work (Marquis, 1983, pp. 32-5; 35-3, 39-3, 40-2, 40-5). One observed incident of incomplete work was recorded for Geometry class. Rob completed about half a page during class study time. His writing was large; the half page was roughly one problem (Marquis, 1983, p. 34-6). An IEP review from seventh grade indicated that Rob had difficulty getting work in on time (Marquis,

1983, p. 52-4).

Other related issues recorded in the fieldnotes were problems with responsibility for his work and for himself (five notations, three of which were perceptions of Ms. Barton and two regular class teachers), poor organizational skills (fifteen notations), and messy work (three notations). Several of these items were cited in the documents from elementary school as well as high school. For example, in the seventh grade IEP review, one area of concern noted in the goals was "self-organization" (Marquis, 1983, p. 52-4). My experience with Rob as a student confirmed the information. He did not obtain assignment information and did not complete all of the required work even with the assignment information, as reported in this particular IEP review when I was the resource teacher for the visually impaired. That pattern seemed to have continued into high school. In the 1980 IEP review, one goal for Rob as a freshman was to "organize himself so he is ready to work on assignments" (Marquis, 1983, p. 52-4).

With a printer and the microcomputer, motivation to complete assignments was evident. The family bought a line printer for their home computer in October, 1982, so Rob could print homework without having to go to a friend's home. Before the family bought the printer, Rob was behind in English assignments and the assignments turned in were not completely satisfactory. Rob was observed as he completed homework for English on the microcomputer (Marquis, 1983, p. 15-3). He had requested that the English teacher permit him to rewrite several themes on which he had received low grades. The English teacher's policy was to permit rewrites if students were willing to do the work (Marquis, 1983, p. 32-5). The English teacher perceived this

volunteering as a positive indication of Rob's interest in the class and a desire to do a better job with homework (Marquis, 1983, p. 32-4). Eight notations were recorded in the fieldnotes of Rob's use of the microcomputer to complete homework; five notations were statements in interviews with Laura and three with his teachers (Marquis, 1983, pp. 15-3; 18-5; 23-6; 32-4; 38-5; 39-3; 51-8; 51-9). He used the microcomputer for completion of homework in English and Consumer Economics classes (second nine weeks only). Both teachers indicated an improvement in the quality of work when the microcomputer was used. Rob also mentioned the use of the microcomputer for homework in Mass Communications and for History during the second semester. For both of these classes, Rob had access to the printer function from the beginning of the semester. He said "that helped me when I did it on the microcomputer" (Marquis, 1983, p. 51-3) because he felt better able to complete homework with the aid of the microcomputer.

Rob also completed some work without the microcomputer. Notations were made during four classroom observations for this, including one in his special education resource class. The Chemistry teacher and the Consumer Economics teacher for the first nine weeks both indicated that he had completed part of the assigned work but had not used the microcomputer to do so. In Chemistry, Rob worked with the self-pacing packets and a textbook. Some of the workbook pages were completed for Consumer Economics without using the microcomputer.

<u>Microcomputer Utilization</u>. Item 2 on the item index was "attention when working on microcomputer." Nineteen notations were recorded for the subvariable "types program commands." One of those notations was a

perception expressed by Ken in the interview (Marquis, 1983, p. 19-11). The other notations were observed incidents in the two microcomputer labs or the high school library.

The second subvariable was "lists or studies program commands." Only three observed incidents of this subvariable were recorded. Ken also spoke of Rob's ability to list and study program commands (Marquis, 1983, p. 19-11).

Eleven observed instances were recorded for the subvariable "runs a program." Once Rob had completed the program commands he often used the "list" function to find mistakes in program commands. Rob usually explained to Greg, the nonhandicapped friend he tutored, exactly what the programs were to do. Finally, the boys ran programs. If program commands were incorrect and the programs did not run as Rob anticipated, he would list, correct, then run the programs again. The observed instances were in the high school library, his home, and the microcomputer labs.

Seven observed instances were recorded for the subvariable "uses a packaged program to do work or play game." In most of these cases, Rob was using a word processing program to complete homework or to teach Ms. Barton the program.

The majority of recorded incidents were for the subvariable "talks about a program or utilization of the microcomputer." Rob explained programming concepts to Greg or how to use programs to Ms. Barton and myself. He discussed programming ideas with Ken, Laura or Todd at home. Several teachers commented on his talking about programming. Rob himself spoke about programming in the interview (Report 51).

Fifty-eight other instances were identified in eleven observations, interviews or other contacts. The highest number of recorded occurrences was at the high school microcomputer lab when Rob explained the use of the word processing program to Ms. Barton (Marquis, 1983, pp. 13-1 to 13-13). The lowest number was one, when Rob's computer expertise was cited by a fellow student in Chemistry, who told another student to "ask Rob" (Marquis, 1983, p. 22-3) about a programming problem.

In no instance in the fieldnotes was any notation made that Rob was inattentive when a microcomputer was involved. His attention seemed unusually intense for a teenager. A time count of attentive behavior was done when Greg and Rob worked at the microcomputer in the high school library. Both Greg and Rob were attentive during the hour in the library. During the nine-minute span of the time count, Rob actually looked away from the video monitor only five times, each for less than five seconds. In the entire nine minute period Rob watched the monitor, although Greg was programming, not Rob. In each of the seven observations when Rob was using a microcomputer, his attention was diverted from the computer for little or no time whatever.

Item 8 concerned Rob's "use of microcomputer concepts and language (jargon)." The three subvariables were: "very knowledgeable," "somewhat knowledgeable," and "little knowledge." Seventy-six notations were recorded in the fieldnotes for the first subvariable. Some of the notations were from observed incidents, some from teacher or parent perceptions expressed in the interviews, and some from other contacts. Rob seemed to know well the things he spoke about in relation to programming. Ken's interview confirmed that this was true.

Notations for the second subvariable were fewer, with twelve recorded. Occasionally, Rob would make command errors or lack some knowledge. In the high school library he got a programming book to help Greg with "loops." He indicated he was unsure of some of the computer applications for other fields (e.g., sciences such as physics).

Three notations were recorded for the subvariable "little knowledge." One involved his attempts to "fix another person's program" (Marquis, 1983, p. 16-3). He could not do it in an instance when a program had been left in the computer and the computer was still on when he arrived at the library. Another instance occurred with a new packaged program the family had just purchased. The program was a more sophisticated disk operating system than he had originally learned. The third instance was a classmate's comment that Rob had not helped him much on a program at some point in time; the remark was made in Chemistry class.

Interactions with Teachers and Peers

Interactions with Teachers

Items 6 and 7 from the item index were concerned with Rob's interactions with teachers in classes. Item 6 was "interaction with teachers in classes or situations where microcomputer is not utilized." The subvariables were "very active," "moderately active," "mildly active," and "withdrawn or inactive." When Rob actually spoke to a teacher or communicated in some way, he was considered to be very active. "Very active" was recorded forty times in the fieldnotes. Twenty-three of these occurrences were with special education personnel, ten were with regular education personnel, and seven were perceptions of teachers or Rob's mother, Laura. Rob spent only two hours of each day in special education

class setting during the first semester and only one hour in special education (physical education) during the second semester. Some of the interaction with special education personnel occurred when Ms. Barton helped him in his English class. Two hours of the school day represented only one-third of his classes. Some discongruence existed between Laura's perception of Rob's interaction with the Geometry teacher and the perception of the teacher himself. Laura noted that Rob was "lovin' Geometry . . . Mr. Green's always been a favorite" (Marquis, 1983, p. 18-7). Mr. Green felt that Rob did not communicate and was withdrawn, but he did feel that Rob was "serious about what he's trying to do" (Marquis, 1983, p. 35-6) in getting the background for computer science.

Seven notations were recorded for the second subvariable of the same item, "moderately active." One was a teacher perception; the others were nonverbal responses to teacher actions (e.g., a teacher handed him a pen).

The third subvariable of Item 6, "mildly active" was noted when Rob smiled or laughed at teacher comments in classes, or showed some kind of interest in the topic of discussion without verbal interaction. Eighteen notations were recorded, twelve occurring in regular class observations. The rest of the notations were either teacher perceptions of his interactions or special education observed occurrences.

"Withdrawn or inactive" was recorded fifteen times. Most of the observation of Geometry on January 13, 1983 fit into this category (Marquis, 1983, pp. 46-2 to 46-6). Seven of the notations were observed in regular classes, the other notations were teacher perceptions from interviews.

class setting during the first week [illegible]

education (physical education) [illegible]

interact or with special [illegible]

invited him to [illegible]

[illegible]

observation on geometry on January [illegible]

(Marquis, 1983, pp. 46-7 [illegible]

in regular classes, the other situations were [illegible]

interviews.

To summarize the data for Item 6, Rob was very active primarily with special education personnel in classes. Fewer observations were made in special education settings and some of the interaction with the resource teacher for the visually handicapped occurred in regular class settings. Rob was rarely very active with regular education teachers. The data indicated he was observed to be moderately active or mildly active with regular education personnel. Rob was not observed often to be withdrawn or totally inactive during the twenty-seven classroom observations (special or regular).

Item 7 was "interaction with teachers in classes where a microcomputer is utilized for completion of homework or for other reasons, or with teachers in other situations." The four subvariables from Item 6 were used in Item 7. All of the observation of Rob with Ms. Barton in the high school microcomputer lab (Marquis, 1983, pp. 13-1 to 13-13) was coded "very active" since Rob was teaching Ms. Barton the use of the microcomputer word processing program. Nine other notations were made for this subvariable, one a perception of a teacher. Since only three teachers were included in this category, the English teacher, the Consumer Economics teacher for the second nine weeks of the first semester, and the History teacher, not many notations were to be expected.

Seven notations were recorded under "moderately active" for Item 7. "Mildly active" showed twelve observed occurrences, eleven of which were from English class observations when Rob laughed or smiled at class activity. One of these was the perception of the English teacher. "Withdrawn or inactive" was recorded ten times in the fieldnotes for Item 7. Six of the notations were for English, two were perceptions of

the English teacher, and two were Ms. Barton's perceptions of Rob's interactions with other teachers for classes where the microcomputer was used in homework completion. She felt that he did not interact with the regular education teachers as much as he should have interacted.

> Ms. Barton: I think that's been a major part of my role, is talking to the teachers, trying to get Rob to talk with teachers, getting some interaction there. . . . I see that as one of the biggest parts in Rob's education. That . . . I don't think he could've pulled through . . . and his parents, also, coming in and doing that. And I think that has made a big difference. And now . . . we're really trying to break away from . . . either their interaction or my interaction with the teachers. (Marquis, 1983, p. 38-8)

Interactions with Peers

Items 3 and 4 addressed Rob's peer interactions "in classes" or "in situations where microcomputer is being used." The subvariables for both items were the same as those used with teacher interactions.

With peers in classes, Rob was noted as being "very active" 102 times. Of those recorded notations, forty-two were with special education students in either special classes or in regular classes and forty-two were with Frank or Steve, nonhandicapped friends with whom he studied in Chemistry. The remaining recorded notations were perceptions of teachers regarding Rob's interactions with peers in classes or actual interactions with students other than those cited here. Although his partner was changed in Chemistry, which did reduce the interactions with Frank and Steve somewhat in the middle of the first semester, he continued to interact with them more than with other nonhandicapped peers in classes.

"Moderately active" was recorded nineteen times. Most of these occurrences were in regular classes when Rob spoke but did not get

the English teacher, and compare [illegible] interactions with other students [illegible] used in homework [illegible] regular [illegible]

[illegible]

with [illegible] and [illegible] continued to interact with them [illegible] peers in classes.

"Moderately active" [illegible] occurrences were in regular classes [illegible]

responses or when he specifically turned to face another student but did not speak. Three of the notations were for special education classes.

Rob was "mildly active" in peer interactions forty-seven times. Seven were for special education situations. "Mildly active" indicated that he laughed or smiled at situations around him but did not interact otherwise.

In class situations, especially regular classes, "withdrawn or inactive" was recorded thirty-four times. Only one occurrence was recorded for special education. Two notations were teacher perceptions expressed in interviews with the resource teacher and the Consumer Economics teacher for the second nine weeks.

Item 4 addressed peer interactions in situations where the microcomputer was central. These interactions were continuous for the three reports of observations in the high school library at the microcomputer. Rob worked with Greg for fifty-five minutes during each of these observations. Periodically, the activity was noted as "very active" (Nine notations were included, although the interaction was steady for fifty-five minutes.) Once Rob interacted with a friend of Greg's who had joined the boys, but for the most part, he ignored both boys when the third one was present. In the interview with Rob, he confirmed that he prefers to work with individuals and not with groups of people. Documents from the elementary school substantiated this as well. In a psychological report written when Rob was twelve years old, the evaluator noted that Rob "seems to prefer assuming a role of being an observer rather than to be actively involved in events going on about him" (Marquis, 1983, p. 52-16).

responses or when he specifically [illegible]

not speak. [illegible]

Rob was [illegible]

[illegible]

[illegible]

report written [illegible]

Rob "seems to [illegible]

be actively involved in [illegible]

10).

Only a single notation was made for the subvariable "moderately active." At the university microcomputer lab, Rob was writing a program to list people's names and addresses. He could not remember the spelling of the last name of a friend from school, which indicated that perhaps he did not know the individual well.

For "mildly active," three notations were made in the fieldnotes. Two of the notations occurred during the time when the third boy joined Rob and Greg. Rob attended to the microcomputer and did not interact with the boys except to ask a question and smile when they made humorous comments.

Rob was only "withdrawn or inactive" in the microcomputer situations when additional people joined the group several times during the three library observations. Six notations were recorded for this. Some referred to the fact that Rob did not interact with the other person, but did with Greg. Additional notations were for lack of interaction with either Greg or the other person.

Expectations of Others and Self-esteem

Item were developed to code implicit and explicit expectations of parents and teachers (both special education and regular education). Each item was assigned six subvariables: "explicit high," "implicit high," "explicit moderate," "implicit moderate," "explicit low," and "implicit low."

Parental Expectations

Parental expectations are high. Both parents stated explicitly in the interview that Rob has the ability to do well in college and in computer sciences. Twelve notations were recorded for this subvariable,

[illegible] only a single [illegible]

actives." At the university [illegible]

[illegible]

Parental Expectations

Parental expectations are high. Both parents [illegible] in the interview that Bob has the ability to do well in [illegible] computer sciences. Twelve notations were recorded for this [illegible] His

eight were Ken's perceptions and four were Laura's. Implicit expectations were also high, with nine notations recorded from the parental interviews, phone contacts with Laura, and from the interview with Ms. Barton. Ms. Barton implied that Rob's parents believed he has the capability to achieve well and become concerned when he does not. They do everything possible to ensure that Rob can achieve. No evidence of the other subvariables was identifed for parental expectations, with the exception of one home observation when Rob's father stated that he was afraid Rob would lose a program if he did not password-protect the diskette. That seemed to imply an "implicit moderate" expectation for some of Rob's microcomputer use.

Most of the parents' comments centered around Rob's use of computers and his ability to achieve with materials adapted for his visual needs. I asked Ken to comment on Rob's interactions and future experiences with the microcomputer.

> Marquis: Do you think that this, then . . . is central, the microcomputer is central in that interaction?
>
> Ken: It is right now, because this is the first . . . opening. For instance, someone who's not doing well in school, but was good in sports, say that you were a good guard on a basketball team, and you had your name written up in the paper, would you have . . . people that would recognize you and would also want to socialize with you because of who you are, and not what you know. . . . And so, the computer to me is in the same realm as . . . you know, being the star guard. Well, not everybody has a home computer. . . . And not everyone at his age has the knowledge that he has. And, the people that are interested in him are also interested in that knowledge, so that's how the computer interplays.
>
> Marquis: It's kind of a status thing. He . . . he holds a degree of status because of his computer expertise, and having one at home.
>
> Ken: Yeah. They first get to know him through the computer, and after that, they find he's not a bad guy after all. But really, it's the computer as far as what opens the door.

Marquis: Do you see that lasting through college? That opening?

Ken: The computer as far as opening the door?

Marquis: Yeah.

Ken: I hope not.

Marquis: Why?

Ken: Because, if the computer is the only . . . if he learns to only open the doors with the computer . . . he can open a lot of doors, but he'll be a very narrow person. He'll see life as only . . . straightforward like the computer-type thing. And he will not see the other side, the other way of life. I see it being . . . a part of the growth pattern that he has, and things like this, but . . . maturity-wise, he'll have to find other ways to open doors, other than microcomputers. (Marquis, 1983, pp. 19-13; 19-14)

Both parents reflected their high expectations for Rob in the comments about grades which were unsatisfactorily low. They indicated that they felt he could do a better job with academic subjects. They both felt that the microcomputer would be a helpful adaptation.

Teacher Expectations

The expectations of special education personnel centered on "implicit high," with seven notations recorded from special education observations and interviews. Two notations of "explicit high" were recorded from the review of documents written by special education personnel. All of these expectations emphasized that Rob is able to do better than he is doing, has greater academic ability than he demonstrates, and is simply not performing to his level of capability. The document review showed that Rob's intelligence has been assessed twice, when Rob was twelve and again when he was almost seventeen (Marquis, 1983, pp. 52-16; 52-21). The quotient fell at the second standard deviation above the mean but his achievement in some subjects is always average

to below average. The IEP review of 1980 reported "C" grades for academic subjects. A school application for the special program in 1973, when Rob was in grade three, showed him at the second, third and fourth stanines for language skills and arithmetic on the Stanford achievement test (Marquis, 1983, pp. 52-3; 52-10). At the sixth and at the seventh grades, Rob performed below the 50th percentile for total scores on the Iowa Tests of Basic Skills (Marquis, 1983, pp. 52-4; 52-5). Only three notations were recorded for "implicit low" expectations from special education personnel; one was the perception of the physical education teacher for Rob's weak physical condition. No evidence of "explicit low" was identified.

The majority of expectations of regular education personnel centered around "implicit moderate." Eleven notations were recorded for this subvariable. Five notations were recorded for "explicit moderate." The Consumer Economics teacher from the second nine weeks had high expectations for Rob, especially with microcomputer work. She mentioned his capabilities twice in the interview (Marquis, 1983, pp. 39-3; 39-7). Seven notations were made in the "explicit low" and "implicit low" categories for teacher's perceptions of what Rob could achieve in regular classroom situations. Discongruence between regular education personnel expectations and both special education personnel and parents existed. Regular education personnel expressed moderate expectations for Rob in relation to regular classroom work based on the kinds of work he was completing but most indicated that they felt he had no problems where computer work was involved.

Self-esteem

"Self-concept or self-esteem" was item 21 on the item index. The following subvariables were used: "strong," "moderate," "somewhat weak," and "extremely weak."

Evidence of "strong" self-concept or self-esteem was recorded a total of fifty-six times. Nineteen of the notations were from remarks made by Rob in the interview. He expressed a positive attitude about facing college, although he knew it would be difficult. He was positive about his abilities in history, science, spelling skills and with computers. Document notations also indicated that Rob did well in social studies areas, in science classes and in spelling. Eight of the fifty-six notations for this subvariable were Laura's perceptions of Rob's self-concept, and seven were Ms. Barton's perceptions of his self-concept. Ms. Barton pointed out that sometimes Rob's self-concept is inflated and he should be more concerned about his progress. He has changed from previous years when he lacked confidence in himself. This perception was expressed by Laura and Ms. Barton; I also perceived a change since the period when Rob was a student in my program. Today hs "just insists on being independent, and self-sufficient" (Marquis, 1983, p. 38-8). The perceptions expressed by Laura and Ms. Barton of Rob's self-esteem were congruent. Both felt that his self-esteem has increased and has become stronger since he became involved with microcomputer use.

Eleven notations were recorded for the subvariable "moderate." Seven of the notations were from the interview with Rob and primarily focused on his feelings about his achievement in Chemistry, the problems

from early in second semester when he was ill, and his notetaking skills.

For the subvariable "somewhat weak," nine notations were recorded. Five of these notations were parental perceptions of his self-esteem. Laura perceived his self-esteem to be lower before he began microcomputer work; Ken believed Rob was still lacking in confidence.

> Ken: With the computer, in subjects . . . like English, where you need to communicate in a written form . . . he's now able to express more things in his own words. And . . . just do a better job. His . . . problem is still in regards to communication. I think he still has a fear of being graded on what he does know in those areas. And I really . . . personally think . . . that's one of the problems he's going through . . . the lack of turning it in . . . 'cause he still doesn't have the pride in it. (Marquis, 1983, p. 19-7)

Six notations were recorded for the subvariable "extremely weak." Three of those were Laura's perceptions of Rob's self-esteem in previous years. He was "dependent," had "no interest in school," and expressed "no opinions" about anything. Rob permitted others to dictate and arrange his life for him. This phenomenon is sometimes characteristic of individuals who have had many surgeries and hospitalizations; they tend to be compliant to the prescribed course of action. As Dr. Walker pointed out, "I don't find that uncommon in kids [not questioning a prognosis or expressing feelings on a prognosis]. They generally go along with whatever the plan is" (Marquis, 1983, p. 41-5). Two notations were Ms. Barton's perceptions of his self-esteem. One notation was from the interview with Rob and was a comment on his poor progress at the beginning of the second semester.

Both Laura and Ms. Barton commented on Rob's stronger self-concept during this school year. They both stated that he has shown an interest

from early in second semester when he was [illegible]

skills.

For the [illegible]

five of these [illegible]

[illegible]

[illegible]

Mr. Saxton's perceptions of [illegible]

interview with Bob and had a comment on [illegible]

ning of the second semester.

Both Laura and Ms. Saxton commented on [illegible] strengths [illegible]

during this school year. They both stated that he has shown an interest

in controlling his own life.

> Laura: One thing was, before he found the computers, he had virtually no interest in school. I mean, furthering his education after high school. I think he always assumed he'd go to college with no idea, and no opinions at all about what college or where, and one thing that really came to me was because before, it seemed that I always had to plan everything. All right, now I'll have him go to such-and-such a school and study such-and-such a thing, and you know, get him ready to do such-and-such. And, no opinions, no interests, really in it to speak of. When he found computers, he found out MIT was one in the nation, number one computer school. The University of Illinois was number two in the nation computer school, and all of a sudden, that . . . those were places he was gonna go to college. . . . It wasn't a matter of . . . "is it all right if I go to college here or there?" It was, "hey, I'm gonna to to MIT!" or "I'm gonna go to the U of I, because that's the two highest in the nation, and I'm gonna get a good job, and in order to get a good job, I'm gonna go to school." And that was it . . . there was no more. And I laughed, because the other day we . . . Ken and I . . . had talked with him and we thought, well, maybe it'd be best if he'd go to First State University . . . one year, because then you could live at home. You can have enough adjustment goin' to school and adjusting to college. The way they do things at college and getting around, finding readers, etcetera, without adjusting to living away from home, too. Then after the summer, when he went over to Second State University [to the computer camp] and got a taste of freedom, he decided . . . no, I'd like to live in the dorm . . . so Ken suggested . . . you could even live at First State University and live in the dorm . . . you don't have to live at home, and still you'd be close enough if you did need . . . well, like the other day, it was . . . "we're gonna have to look into some things because I'M goin' to U of I next year." And I said, "what happened to First State University?" "Well, that was never MY idea!" he said. And it tickles me to get definite opinions . . . he's got his mind made up, what he wants, and that is SO unlike what we had two years ago. (Marquis, 1983, pp. 18-10; 18-11)

Comments from Ms. Barton were similar. She noted that before this year, he was passive and did not try to control his own life.

> Ms. Barton: He didn't have any desire to make up his mind on anything. He was HAPPY to live by whatever anybody chose for him. . . . You choose red, blue or green, and I'll live with whatever you choose. And didn't have any desire . . . you can't develop responsibility in someone who doesn't want it.
>
> Marquis: Right. That's exactly the pattern I saw, too, between the years of third grade and eighth grade.
>
> Ms. Barton: Yeah. And even through his eleventh grade year, I saw him being like that. Now, lately, he's . . . really starting

in controlling his own life.

Laura: One thing was, [illegible]

yeah, he was [illegible]

Ms. Barton: [illegible] anything. [illegible] him. [illegible] whatever you choose. And [illegible] develop responsibility in someone [illegible]

Marquis: Right. That's exactly the pattern [illegible] the years of third grade and eighth grade.

Ms. Barton: Yeah. And even through his eleventh grade year I saw him being like that. Now, lately, he's . . . really starting

> to make up his mind on his own about things and [laughter] on a few occasions has just stood up and said "No! . . . This is what I'll do." . . . I think that's a big stepping stone . . . that he feels it's okay to say "no, I don't wanta do that!" (Marquis, 1983, pp. 38-10)

Summary of Data

Recorded notations in the data indicated several major themes. For the most part, Rob's visual functioning was limited for print reading and required enlarged material. He could read regular print, but slowly. Rob could read the characters on the screen of a TRS 80 (Model I or Model III) microcomputer. (Visual fluctuations generated problems even with the microcomputer screen in the second semester.) Rob had problems reading the chalkboard when that was necessary. Travel was slow and cautious with Rob always watching carefully. He could locate or track objects and people visually, but sometimes had difficulty when vision was fluctuating. Adaptations were made for print materials in classes. These adaptations were for notetaking, some test materials, and for textual materials.

Rob was not perceived as having limitations physically but the visual handicap was perceived by parents, teachers, and physicians as limiting Rob's performance. With adaptations, Rob's parents and special education personnel felt he was not handicapped. Regular education personnel perceived Rob as more limited than did parents or special education personnel.

Rob interacted with special education personnel more than with regular education personnel. He was more often moderately active or mildly active in regular education situations than very active. With nonhandicapped peers, Rob was moderately active to inactive unless the microcomputer was central to an activity. Rob had more interaction with

special education peers, even in regular class settings.

For the most part Rob listened to gain inforamation in classes. He did not often ask or answer questions. In classes where he was directed to work or follow in the book, he did so. Homework completion was a problem in classes. Rob attempted to catch up on late work when the family bought a microcomputer printer; the only class for which this proved effective was English. In Geometry and in Chemistry, work which was late or incomplete had to be completed by hand. Rob was reported to have completed some of the work for several classes but not other portions of the work.

Rob was very active and very knowledgeable when the microcomputer was involved. He was observed to be very involved when he tutored Greg, a nonhandicapped peer. At home, Rob also spent much time working with the microcomputer.

Others' expectations for Rob were higher when the microcomputer was considered. Both of his parents and the special education personnel indicated high expectations for Rob, especially after he began the work with microcomputers. Regular education personnel expressed moderate expectations to low expectations for his regular class work but recognized his potential for computer work.

Rob's self-esteem was strong, which was reported to be a change generated from the microcomputer work. The maturation and change were attributed to the microcomputer by his parents and by Ms. Barton, the resource teacher. Rob initiated interaction with the English teacher to rewrite themes and catch up with incomplete work. In Chemistry, Rob used free time to catch up on work by himself. He felt good about the

special education peers, even in regular class [illegible]

For the most part Joe [illegible]

He did not often ask for teacher assistance [illegible]

difficulty to work on [illegible]

was a problem [illegible]

[illegible]

[illegible]

generated from the [illegible] [illegible]

attributed to the [illegible] [illegible]

resource teacher. Rob [illegible] interaction with the [illegible]

to rewrite themes and catch up with incomplete work. [illegible]

used free time to catch up on work by himself. He [illegible]

possibilities open to him for work in computer science applications combined with other science areas. Rob was showing more interest in being an active participant in planning his own future. His new computer expertise was surely the major factor in both the interest and the participation.

possibilities open to him for work or careers [illegible]
combined with other science areas. [illegible]
being an active participant in planning [illegible]
activities [illegible] major [illegible]
participation.

CHAPTER V

SUMMARY AND DISCUSSION

Summary

This study investigated the impact of microcomputer usage on the educational experiences of Rob, a low vision student. The study was designed as a single subject case study using ethnographic research methodology. Participant observation in natural settings of school and home provided the majority of the data. Interviews and the study of documents from the school records provided substantiating data for the study.

The data-gathering process was conducted from July, 1982, through February, 1983. Observations were made in classrooms, Rob's home, and extraclass situations. Interviews were conducted with Rob's parents, teachers, physicians and Rob himself. Fieldnotes were recorded and transcribed. An item index was formulated from the emerging patterns and themes generated by the data. Fieldnotes were analyzed with respect to the variables of the item index which addressed the original research questions and with respect to other behavioral patterns identified during the data-gathering and analysis stages which related to the central concerns of the study.

Discussion

Research Questions

Research Question 1: What was the influence of microcomputer usage on the environment and experiences of a low vision student?

[illegible]

[illegible] the study.

[illegible]

Research Questions

Research Question 1: What was the influence of [illegible] on the environment and experiences of a low vision student?

Visual functioning was a key element in Rob's ability to use the microcomputer. Rob's residual vision fluctuated almost daily, which made some kinds of visual use difficult or impossible. Rob did not read fine print at all, and did not read regular print with a positive image (black on white) quickly enough to use print materials effectively for classwork on a consistent basis. Observing his behavior at different visual tasks established that the microcomputer screen was one print source which he could read on a consistent basis, except at times of severe visual fluctuations. The capability of the microcomputer to generate larger characters enabled Rob to read the video monitor even with visual fluctuations. When the loss was most severe, in January, 1983, Rob did not even read with the microcomputer.

The data supported the concept that Rob learns best through listening. In classes where the chalkboard was central to class activity, Rob was less active than in classes where he was able to obtain information through listening. Geometry was an example of a class where students must see the chalkboard to achieve. The visual characteristics of a chalkboard are similar to those of a microcomputer but the quality is far different. Distance presents a problem with chalkboards. Handwriting of different individuals cannot be controlled. The visual cues are light (chalk) on dark (board), but the contrasts are not distinct as on the microcomputer screen. For a low vision student who learns best through listening or very close print reading, the chalkboard hinders the learning process. Interactions with both peers and teachers in such cases would be limited by the inability to use the medium for full participation. Regular class teachers would not necessarily recognize reduced participation and lack of interaction

as related to chalkboard use. The behavior could be mistaken for lack of motivation or poor attitude.

Microcomputer utilization provided Rob more participation in a variety of experiences, including classes and peer interactions. Using the microcomputer gave Rob access to the same kinds of materials and experiences sighted peers could enjoy with a print medium. Microcomputer use allowed Rob to be a more active participant in some situations. For example, the report regarding the use of microcomputers given in the Consumer Economics class of the second nine weeks established Rob as an expert. The report had been composed on the microcomputer and looked good in final form. Students responded well to his presentation.

Rob's self-esteem was improved in several ways with the use of the microcomputer. He experienced success with it and developed expertise to make the technology work for him. He could make the microcomputer do what he wanted it to do without the need for dependence on other people. Rob became a more effective and creative individual. He was recognized as an expert in the school setting by peers and teachers alike. Rob became a person on whom nonhandicapped peers could depend for help with the technology.

If Rob had difficulties in completion of work, he got behind in his classes. Having the printer at home gave him an opportunity to catch up with assignments more quickly and efficiently than doing the makeup work tediously by hand. This development generated the initiative for Rob to ask permission to redo English homework. He also took the initiative to spend his out-of-class hours to make up Chemistry work. The possibilities of computer work for his vocational future and the reality of the microcomputer for homework completion generated changes

in Rob's behavior which were important. Had the line printer been available earlier in the first semester, Rob might not have fallen behind. When he had access to the printer, completion of assignments was reported to have improved, both for quality and quantity. The pattern of not organizing or accepting responsibility for homework completion began to shift when the resources were available to him. Rob's good self-concept in relation to his ability to produce with the microcomputer gave him the impetus to follow up on completion of work and rewriting of less acceptable assignments.

Rob's interest in the microcomputer and in computer science generated the initiative to take classes which would prepare him for applied computer sciences studies in college. He had not taken enough mathematics and sciences courses and recognized the need for the skills when he decided that he wanted to be a computer specialist. Once Rob had established an activity in which he felt competent and successful, he moved from a passive role to a more active role in the control of his life. Rob had previously allowed decisions to be made for him and plans to be made for him. According to his parents and the resource teacher, he did not seem interested in controlling factors in his life.

Expectations of his parents and the resource teacher for the visually handicapped were high. Expectations of others were low to moderate, with the exception of his computer expertise. Teachers and parents expressed the feelings that he functioned as a handicapped individual in most situations (especially the regular classroom) unless adaptations were made, in which case Rob could function more effectively. For microcomputer usage, Rob was not viewed as handicapped.

in Rob's behavior which were important. [illegible]

available earlier in the [illegible]

behind. When [illegible]

was [illegible]

[illegible]

parents expressed the feelings that [illegible]

individual in most situations (especially [illegible]

adaptations were made, in which case Rob could function [illegible]

For microcomputer usage, Rob was not viewed as handicapped.

Research Question 2: What was the effect of microcomputer usage on the interaction of the student with peers?

Rob interacted primarily with special education students in both his special education class settings and in his regular division class settings. He rarely interacted with nonhandicapped students in any class settings except Chemistry. The nonhandicapped student with whom Rob interacted in Chemistry on a consistent basis had been a classmate since grade school days. Rob did not initiate many contacts with nonhandicapped peers, but began to do so during his senior year.

In settings where the microcomputer was central, Rob interacted on a limited but intense basis with peers who were nonhandicapped. The limitations involved one-to-one interaction. By his own admission, Rob preferred working with individuals. He did not interact as much when additional people joined the activity with the microcomputer while he tutored Greg in the high school library. Rob indicated that two boys had become his good friends through microcomputer use. One was an individual from the computer camp; Greg, the other. This kind of interaction was a change from previous years, according to Rob's parents and Ms. Barton, the resource teacher.

Research Question 3: What was the effect of microcomputer usage on the interaction of the student with teachers?

Rob demonstrated a tendency to interact primarily with special education personnel either in special class settings or in regular classrooms where he received special support. Interactions with regular class teachers were less active. In some cases he seemed to be inactive or withdrawn. The nature of the class seemed to influence these

interactions. In classes where he could listen, he interacted more. He interacted less in classes which relied heavily on visual materials, especially the chalkboard, and visual use.

Rob did interact more positively with regular education personnel when he could use the microcomputer to complete homework. Expectations of regular education personnel for Rob were only moderate, except when computer knowledge and utilization were considered. His interactions with the English teacher and the Consumer Economics teacher for the second nine weeks were increased when he used the microcomputer to redo homework and write/present a final project. Using the microcomputer improved his ability to communicate in an acceptable manner.

Research Question 4: What was the effect of microcomputer usage on the student's completion of assignments in high school courses?

As noted earlier, using the microcomputer allowed Rob to complete some assignments with great success and to redo other assignments to improve the quality of his work. The impact on homework completion was limited, however. Homework which might ordinarily have been done on a typewriter could be done using the word processing program. Other kinds of work, for example Geometry and Chemistry, could not be done because appropriate software was not available. Mr. Green, the Geometry teacher, feels that such software is a future possibility, but Rob will be out of high school when it becomes a reality. If the communication tool had been accessible for Chemistry and Geometry classes, perhaps his class participation would have improved and achievement level would have been higher. The technology is so new that teachers do not have the expertise to create software which would provide the same instructional material

as the texts provide. Rob was actually ahead of the education field in terms of his ability to use the technology.

Recommendations for Further Research and Development

More research is needed in special education applications of microcomputer technology. Based on the findings of this study, the following recommendations were made for future research consideration.

1. Research should address technological aspects of microcomputer hardware. Evaluation and comparison of video monitors among different brands needs to be made. Contrasts of background need consideration, as well as angle and size of characters. Different visual conditions may require different video monitor characteristics for optimal utilization.

2. Research should explore software development of classroom materials for general use by low vision students. In addition to teacher-prepared computer assisted instructional software, great potential exists for textual materials to be stored on diskettes. Accessibility of textual material for low vision students is the key to achievement, especially in mainstreaming situations where competition with nonhandicapped peers is important. Microcomputers will be used in public education and are not considered adaptive materials. Visually handicapped students using microcomputers will not be considered different from nonhandicapped peers.

3. Achievement studies of low vision students who read materials provided for microcomputer usage should be compared with achievement of low vision students who read materials

provided in taped form or large print form.

4. Teacher training programs should address materials development and utilization of the technology. Teachers of the visually handicapped must be up-to-date with the technology in order to provide instruction for visually handicapped students. Training in development of computer assisted instruction materials and adaptation of commercially prepared instructional materials is necessary.
5. Output modes need to be developed which allow more than a single output source for individuals with fluctuating vision. Such development should seek to minimize costs and maximize utility for low vision individuals.
6. Research should address the processes of creativity and problem-solving through programming skills. Individuals who can program computers develop vocational possibilities, but also expand analytical skills and creativity. Effective problem-solving is a goal for all individuals. Computer programming requires the use of creativity and effective problem-solving. Visually handicapped students who use computers should function more effectively with enhanced problem-solving skills. Microcomputer technology provides a convenient tool for instruction in these skills through programming.

Limitations of the Study

The present study investigated a single subject, making generalizations to a population of low vision students inappropriate. However, the findings of this study provided implications which may be useful for educators of the visually handicapped. Rob used the microcomputer

with success. Low vision did not impede his ability to read the video monitor except during times of severe visual fluctuations. Other visually handicapped students can also be expected to read video monitors. Because the microcomputer is not an adaptive aid unique to the visually handicapped, visually handicapped students can potentially be mainstreamed more effectively when the equipment and the software are accessible.

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APPENDIX A

Field Report Information

LISTING OF FIELD REPORTS

Type	Report Number	Date	Time	Content	Amount of Time (min.)
P	1	7/18/82	7:15 p.m.	Phone call to Rob	10
O	2	7/28/82	7:00 p.m.	University Microcomputer Lab	125
C	3	9/14/82	8:01 a.m.	Notes on phone call from Chemistry teacher; encounter in hall with teacher of computer class	15
O	4	9/14/82	9:05 a.m.	Physical Education (special)	50
O	5	9/14/82	9:55 a.m.	Study Skills (special)	60
O	6	9/16/82	8:00 a.m.	English	55
O	7	9/21/82	7:55 a.m.	English	60
O	8	9/21/82	12:02 p.m.	Consumer Economics 1[9]	55
O	9	9/21/82	1:02 p.m.	Geometry	55
O	10	9/22/82	11:03 a.m.	Chemistry	55
O	11	9/27/82	10:59 a.m.	Chemistry	55
O	12	9/27/82	11:58 a.m.	Consumer Economics 1[9]	55
		9/28/82	7:59 a.m.	Ill	-
O	13	10/28/82	3:04 p.m.	Microcomputer Lab, high school	55
O	14	10/8/82	2:01 p.m.	High school library (microcomputer)	55
O	15	10/12/82	7:10 p.m.	Rob's home (microcomputer)	55
O	16	10/18/82	2:04 p.m.	High school library	55
O	17	10/20/82	7:05 p.m.	Rob's home (microcomputer)	90
I	18	10/20/82	8:30 p.m.	Interview with Laura (mother)	25
I	19	10/27/82	7:10 p.m.	Interview with Ken (father)	25

Type	Report Number	Date/Time		Content	Amount of Time (min.)
		10/29/82	2:00 p.m.	Ill	-
0	20	11/5/82	12:59 p.m.	Geometry	55
0	21	11/5/82	2:05 p.m.	High school library	55
0	22	11/9/82	11:05 a.m.	Chemistry	50
0	23	11/15/82	7:59 a.m.	English	55
0	24	11/16/82	9:05 a.m.	Physical Education (Rob did not come)	50
0	25	11/16/82	10:05 a.m.	Study Skills	55
0	26	11/19/82	12:01 p.m.	Consumer Economics 2[9]	55
C	27	11/21/82	6:00 p.m.	My home (note on saving data)	30
0	28	11/23/82	11:05 a.m.	Chemistry	55
I	29	11/23/82	5:00 p.m.	Interview with physician	30
0	30	11/24/82	7:55 a.m.	English	55
I	31	11/24/82	9:05 a.m.	Interview with Chemistry teacher	20
I	32	11/24/82	9:30 a.m.	Interview with English teacher	20
0	33	11/30/82	11:55 a.m.	Consumer Economics 2[9]	55
0	34	11/30/82	12:58 p.m.	Geometry	55
I	35	12/7/82	10:00 a.m.	Interview with Geometry teacher	20
0	36	12/9/82	7:58 a.m.	English	55
0	37	12/9/82	11:58 a.m.	Consumer Economics 2[9]	55
I	38	12/10/82	9:00 a.m.	Interview with Resource teacher for Visually Handi-capped	30
I	39	12/17/82	1:45 p.m.	Interview with Consumer Economics teacher, second quarter	15

Type	Report Number				Amount of Time (min.)
I	40	12/17/82	2:10 p.m.	Interview with Consumer Economics teacher, first quarter	15
I	41	12/30/82	5:00 p.m.	Interview with ophthalmologist	30
P,O	42	1/1/83	6:00 p.m.	Phone call to Rob's mother	15
O	43	1/6/83	1:00 p.m.	Mass Communications	55
O	44	1/7/83	10:02 a.m.	History	55
O	45	1/12/83	9:05 a.m.	Physical Education	55
O	46	1/12/83	11:00 a.m.	Chemistry	55
P,O	47	1/19/83	9:00 a.m.	Notes on phone call to Rob's mother	30
		1/20/83	9:59 a.m.	History	20
O	48	1/20/83	12:59 p.m.	Mass Communications	55
I	49	1/27/83	10:15 a.m.	Interview with Coach	20
P,C	50	1/29/83		Notes on events of past week: Rob was ill for one week--Phone call to Rob's mother	30
I	51	2/8/83	7:10 p.m.	Interview with Rob	30
C	52	2/22/83 & 2/23/83	9:00 a.m. 9:00 a.m.	Document Review-- School Records	120 120

Key: P = Phone call
O = Observation
I = Interview
C = Other contact, document review

SUMMARY OF FIELD REPORTS

	Total	Number of hours/minutes	
Classroom observations	27	24	40
Interviews (formal)			
Teachers	7		
Parents	2		
Doctors	2		
Rob	1		
	12	4	40
Microcomputer work at high school	4	3	40
Microcomputer lab/university	1	2	0
Home observations (microcomputer)	2	2	30
Other contacts (phone conversations, informal meetings)	5	1	40
Document Review	(2 days)	4	
		43	10

APPENDIX B

Item Index

LIST OF INDEXING ITEMS

1. Attention in classes

   a. Watches teacher, pays attention, active
   b. Asks or answers question
   c. Watches chalkboard
   d. Listens, but watches floor or books
   e. Follows in book or studies if directed to do so, takes notes
   f. Inattentive

2. Attention when working on micorcomputer

   a. Types program commands
   b. Lists or studies program commands
   c. Runs a program
   d. Uses a packaged program to do work or play game
   e. Talks about a program or utilization of the microcomputer
   f. Inattentive

3. Interaction with peers in classes

   a. Very active
   b. Moderately active
   c. Mildly active
   d. Withdrawn or inactive

4. Interaction with peers in situations where microcomputer is being used

   a. Very active
   b. Moderately active
   c. Mildly active
   d. Withdrawn or inactive

5. Interaction with family members

   a. Very active
   b. Moderately active
   c. Mildly active
   d. Withdrawn or inactive

6. Interaction with teachers in classes or in situations where microcomputer is not utilized

   a. Very active
   b. Moderately active
   c. Mildly active
   d. Withdrawn or inactive

7. Interaction with teachers either in classes where microcomputer is utilized for completion of homework or for other reasons

   a. Very active
   b. Moderately active
   c. Mildly active
   d. Withdrawn or inactive

8. Use of microcomputer concepts and language (jargon)

   a. Very knowledgeable
   b. Somewhat knowledgeable
   c. Little knowledge

9. Completion of homework

   a. Completes homework, uses microcomputer
   b. Completes homework, does not use microcomputer
   c. Does not complete homework (observed or reported)

10. Ability to read print

   a. Regular print, dark on white
   b. Fine print, dark on white
   c. Enlarged materials, dark on white
   d. Video monitor, regular size, white on dark
   e. Video monitor, enlarged ("poked") characters, white on dark
   f. Chalkboard

11. Others' perceptions of R's ability to read print

   a. Regular print, dark on white
   b. Fine print, dark on white
   c. Enlarged materials, dark on white
   d. Video monitor, regular size, white on dark
   e. Video monitor, enlarged ("poked") characters, white on dark
   f. Chalkboard

12. Other visual functioning

   a. Confident in travel
   b. Cautious in travel
   c. Bumps objects or people
   d. Tracks objects or people visually
   e. Locates objects or people visually
   f. Positioned appropriately for use of functional vision
   g. Positioned inappropriately for use of functional vision

13. Effects of the visual impairment on performance, as perceived by parents

    a. Explicit perception: handicapped
    b. Explicit perception: not handicapped
    c. Implicit perception: handicapped
    d. Implicit perception: not handicapped

14. Effects of the visual impairment on performance, as perceived by special education personnel

    a. Explicit perception: handicapped
    b. Explicit perception: not handicapped
    c. Implicit perception: handicapped
    d. Implicit perception: not handicapped

15. Effects of the visual impairment on performance, as perceived by regular education personnel

    a. Explicit perception: handicapped
    b. Explicit perception: not handicapped
    c. Implicit perception: handicapped
    d. Implicit perception: not handicapped

16. Effects of the visual impairment and physical impairment on performance, as perceived by physicians

    a. Explicit perception: handicapped
    b. Explicit perception: not handicapped
    c. Implicit perception: handicapped
    d. Implicit perception: not handicapped

17. Effects of the visual impairment on performance, as perceived by peers

    a. Explicit perception: handicapped
    b. Explicit perception: not handicapped
    c. Implicit perception: handicapped
    d. Implicit perception: not handicapped
    (Note: No evidence of this was found.)

18. Parental expectations

    a. Explicit high
    b. Implicit high
    c. Explicit moderate
    d. Implicit moderate
    e. Explicit low
    f. Implicit low

19. Special education personnel expectations

    a. Explicit high
    b. Implicit high
    c. Explicit moderate
    d. Implicit moderate
    e. Explicit low
    f. Implicit low

20. Regular education personnel expectations

    a. Explicit high
    b. Implicit high
    c. Explicit moderate
    d. Implicit moderate
    e. Explicit low
    f. Implicit low

21. Self-concept or self-esteem

    a. Strong
    b. Moderate
    c. Somewhat weak
    d. Extremely weak

22. Adaptations made in classes or other situations

    a. Visual (materials, aids)
    b. Physical (materials, activities, preferential seating in classes)
    c. Extended time for work completion
    d. Help of resource teacher or aide
    e. No adaptation needed

23. Role of the researcher

    (Notations were made in the field notes for the researcher's benefit.)

24. Organizational skills

    a. Poor
    b. Satisfactory

25. Work

    a. Messy
    b. Neat

26. Appears to be asleep

27. Interacts with aide in a regular class

28. Ill

29. Vision fluctuating

30. Responsibility problems reported

APPENDIX C

Sample Fieldnotes

SAMPLE FIELDNOTES—OBSERVATION

REPORT 2

7/28/82   7:00 p.m.

University Microcomputer Lab

Picked Rob up at home

Brought Rob to university

Rob demonstrated many of his BASIC programs, his own diskettes

Man from a university class asked for help

Rob explained BASIC concepts to me

7/28/82   7:00 p.m.

I had spoken to Rob's mother the previous night, and she felt that I could make Rob even more comfortable with my presence if I took Rob out with me to do something, like going to the microcomputer lab at the university. This evening I picked him up, having asked him if he'd like to go with me and show me a few things. When I arrived at the house, I heard his mother telling him to change his shorts to long pants; "she won't want to take you looking like that!" As I got out of the car, Rob's mother, Laura, could see that I also was wearing shorts and yelled, "Marquis!" I told Rob that we could "ignore her," and he grinned. (I believe this did more for rapport than anything I could have consciously planned!)

We exchanged pleasantries riding over in the car, and when we walked to the building, Rob informed me he could see the curbs well enough that he did not need sighted guide help from me. I noted he was cautious, especially on the steps to the building, but he did not stumble at any point. It was still quite light.

In the microcomputer lab, I introduced Rob to Dr. Johnson, a member of the special education faculty of the university. She was taking a microcomputer class designed for educational materials development. We settled at a machine, and Rob booted his diskette. He called up a program which he had written in BASIC with the help of his father, who is a computer systems analyst for a large international corporation based in the community. The program can retrieve lost information (which has been "killed" or "crashed") from any disk. Rob used a term which was new to me, "wrap"; I will have to ask him the meaning of this term.

A young man from the class seemed to notice the expertise with which Rob was explaining the program to me, and said, "Excuse me," from Rob's left. (This is the side with the functional vision.) The man asked for help because of a programming problem. Rob tried to help. The man showed him the program, which Rob could not see. Rob did not enlighten the man as to that fact, but told the man verbally what should be done. Rob also said that the man should "just explain the problem," and he indicated he would be able to understand by listening. The man finally said, "I can't follow, sorry to bother you." He went off to get help from the course instructor.

Rob showed me how to write a program in BASIC. I, of course, understood very little of what he was doing or why he was doing it. Some of the dialogue included in his explanation of what he was doing follows.

Rob: I'm sorta buildin' a type-a program . . . when I hit "BREAK", it puts all those commands in a file.
He explained TRSDOS to me; "without it, you can't run a disk." (Later, I discovered that a DOS is any particular machine's Disk Operating System, and TRSDOS does that function for the TRS microcomputer.) TRSDOS is "the machine's language . . . with the commands, you can use the disk and use BASIC."

Marquis: (pointing to the screen) Can you see the print on there?

Rob: Yeah!

Marquis: No problem?

Rob: Yeah, no problem! BASIC is just English.

Rob told me about his tutoring. Some parents are interested in having their children take it, but "$10 an hour is too much!" Rob likes

to work with individuals, not with groups.

Rob: . . . so I can answer questions. I sit and type (in free time). That was my favorite thing to do when I was lab monitor.

Marquis: Oh, you were lab monitor?

Rob: Yeah. (He continued telling me that he would go home at night and "do" others' projects from memory after seeing them, just for practice.)

Rob sat and created a program for names and addresses, then typed in some names and addresses. For a minute, he couldn't think of any names.

Marquis: How about a friend at school?

Rob typed "Jeff" and told me the last name.

Rob: I can't spell it! My dad always gets mad at me.

Marquis: Why?

Rob: Because I always kill everything. (When he is finished playing with a program, he "kills" or deletes a newly created program.) I usually just kill it and forget it.

Marquis: You don't kill stuff you need?

Rob: Noooooo, I don't kill stuff I need!

Rob showed me how to print bigger characters and symbols which do not appear on the keyboard. The process of making the characters larger is called "poking" them. I asked, "You say you 'poke' them?" He laughed, "yeah." Rob continued to show me a number of things which can be done on the machine, most of which I did not remember or understand. Eventually, we exhausted the "lesson" possibilities and I took Rob home.

to work with individuals, not with groups.

[illegible]

is called "putting" [illegible]

"yeah," [illegible] continued to show me [illegible]

the machines, most of which I did not pretend to understand. [illegible]

we exhausted the "lesson" possibilities and I [illegible]

SAMPLE FIELDNOTES—INTERVIEW (PARENT)

REPORT 19

10/27/82 7:10 p.m.

Rob's Home

Interview with Ken, Rob's father

Transcription of cassette tape

Father's feelings about impact of microcomputer on Rob

Comments on how microcomputer had been instrumental in development of peer relationships for Rob

10/27/82 7:10 p.m. Interview with Rob's father Rob's home

Tonight, I came in and visited briefly with Rob's mother. Rob was off in his own room doing something which was never specified. I went to the computer room and visited with Ken, Rob's father, for a few minutes. We discussed software for the microcomputers. Then we decided that the computer room would be an appropriate place for our interview. The transcription which follows is of that interview.

Marquis: Laura started out by telling me a couple of weeks ago that she thought Rob had "found his niche," and maybe you'd like to respond to that, too.

Ken: Okay. Um, let's see. With . . . uh, handicapped people the computer has two advantages. One is that . . . like, in Rob's situation, with him having limited sight, with having a screen where the light comes through, he's able to see it where he couldn't see normal print the same size. The other advantage to it is . . . with the setup we have, with the printer, he is able to see it on the screen, as HE sees it, and then use the printer to communicate to quote "sighted" people, and so that gives him a better communication tool. And so, to me, that's why he's found his "niche" . . . because now, he's able to communicate his thoughts in his own words to people he wouldn't be able to communicate to before. Uh, further, . . . as far as an occupation, with . . . with the computer, a large company such as mine, by them putting more manuals and things like this on the computer system, a person such as in Rob's situation can get to resource materials much easier than it could be when it was all printed text, and in books. And so, there again, that's where it may help him regarding a job, because he's able to get to the same material that a sighted person can get to, to do his job, and be just as productive.

10/27/82 7:40 p.m. Interview [illegible]

Tonight, I came in [illegible]

[illegible]

like this, on the computer systems, [illegible]

get to resource materials much easier than he would be [illegible]

printed text, and in books. And so, that's again, [illegible]

help him regarding a job, because he's able to get to the same materials

that a sighted person can get to, to do his job, and be just as productive

"Cause, like, just as far as Sarah Martin's situation at work, the key to her success, and I've been following up with that at work, is . . . I'm interested for two reasons. One, this goes with Sarah, and the other thing, just seeing how the company reacts to her and how it may react to Rob or somebody like him. And, it's given her an opportunity, though she's totally blind, with a computer system. It's given her a chance to . . . to be productive, the same as anyone else. And so, that's where, like the computers in Rob's situation, he may have found the niche, or may have found the occupation that matches to his personality and gives him the opportunity to be productive just like anyone else.

Marquis: How long ago did he start using a micro?

Ken: Um . . . let's see . . . I would say that he's had access to one for, like two and a half years. What he started out doing was . . . they've got . . . had a Model I computer in the library at the high school. And he started going down there at his break periods, using the computer.

Marquis: Did you have this (I pointed to the Model III on the table) at home then?

Ken: No, we just had . . . we've just had this one since, uh, May of '81. And so, he's only had access to the computer at home since May of '81. Now, he's had two . . . two summers where he did not have a job. So, therefore, he worked a great deal of time on the computer. And a lot of things he knows for the computer is through experimentation, rather than to read manuals. Example: well, he's also used the computer to turn around and teach him, too. Because, like for instance, we bought a . . . a package that told about basic languages, on the Radio Shack

computer, on tape, which he read it . . . read into the computer. And he used that to teach him more concepts about the computer, where again, he wouldn't see it if it was a large printed word. Same thing as far as on the disk operating system, that once you can break into it, and once you understand it, you can use library commands, and things like this, and let the computer teach you. The other thing . . . is . . . that I have tried to explain to him things about computers, so he's just not goin' ahead and pushin' buttons, and gettin' responses. He actually knows WHY it does something, why it's set up a certain way, why a number is a certain length, and things like this, and so he's got a better understanding why certain pieces of equipment have to be together to get a certain job done. So, that's . . . that's, you know, both how the computer has helped him increase his knowledge, and also, why the computer right now appears to be his niche, 'cause that IS givin' him his chance to communicate.

SAMPLE FIELDNOTES--CLASSROOM OBSERVATION

REPORT 28

11/23/82 11:05 a.m.

Chemistry

Interaction with three boys, but primarily Frank and Steve

Students work independently or in small groups on projects

Interaction about the school play, and singing from it

Mr. Taylor reprimanded the back table

11/23/82 11:05 a.m. Chemistry

When I came in, part of the class had come across the hall to the laboratory, and part had remained to talk to Mr. Taylor in the lecture room. Rob had come into the laboratory. Steve and Frank were already in the lab, sitting in the back (their usual south corner) and talking. They laughed as the principal made a mistake in an announcement over the intercom. He had made the announcement to correct a mistake in an earlier announcement, and the boys thought it was funny. The boys turned to me and asked if I wrote down "EVERYTHING" that they said. I laughed and replied "of course!" A girl at the middle table looked back quickly to see what my reply would be; I wonder if they suddenly had become concerned about it. When they all went back to what they had been doing earlier, I decided that they were curious, but not worried.

At the beginning of class, Rob stood in the northwest corner of the room for a few minutes, studying the very large wall poster of the elements and their abbreviations. When Mr. Taylor came in at 11:08, Rob talked to him and got a tape recorder/player, which Rob brought back and plugged in. As he plugged in the equipment, he spoke to me about my word processing program. He had not worked on the program yet, as his brother had done the same thing (lost data), and Rob and Ken were retrieving Todd's data first. Rob went back to the front for a minute and came back to his seat to work.

Rob: Well, Frank, how long's it gonna take you to complete six?

Frank: Tomorrow, maybe.

Rob: Tomorrow, uh-huh!

Rob listened to the tape, which had a man's voice on it.

Frank: When are YOU taking five, Rob, tomorrow?

Rob gave no indication of hearing him. He listened to the tape player which sat on his desk and wrote into the notebook which was on his lap. He was hunched over quite far.

I looked around and noted that several students were missing today. But, for the most part, the small groups and pairs were still intact. The two groups at the east and west center island/tables had merged into the main center aisle by turning their chairs a bit. Most of the students seemed to be working. Steve and Frank were reading together about solids and gases. Rob continued to write and listen. At 11:19, another student and his partner came in to talk to Mr. Taylor; a minute later, still another student I had though absent came in with a handful of papers. At 11:20, Rob stopped the tape and listened.

Frank: Steve, when are the play days?

Steve: December third, fourth, and fifth. . . .

Steve was to play the lead character in the school play. I tapped him and asked, "are YOU the lead?"

Steve: Yeah! You didn't know that?

More discussion followed, about the play.

Rob: He'll be the best there ever was.

Rob gave no indication of hearing him. He [illegible]

which sat on his desk and [illegible]

He was hunched over [illegible].

[illegible] looked [illegible]

[illegible] of the coat [illegible]

The [illegible] of the [illegible]

[illegible]

SAMPLE FIELDNOTES--INTERVIEW (TEACHER)

REPORT 39

12/17/82 1:45 p.m.

Interview with Ms. Wilson, Consumer Economics teacher (second nine weeks)

Rob's progress for the nine weeks period

Rob's completion of homework

Rob's final project

Feelings on Rob's interaction with peers

12/17/82 1:45 p.m. Interview with Ms. Wilson, Consumer Economics teacher for Second Nine Weeks (her alternate classroom)

We spoke briefly, and I could sense that Ms. Wilson was a bit hesitant about the interview. She did agree to be taped when I told her the nature of my study and what I was basically observing in Rob's classes.

Marquis: I'm interested in Rob's progress in your class, and as I said, I'm interested in his interaction either with his peers, or with you, and, um, whatever you want to tell me about that.

Ms. Wilson: Umm, for the sem . . . this nine weeks, he got a "C," which I think he got a "C" last time. I don't know, 'cause I didn't have him last nine weeks. Mrs. O'Brien had him last nine weeks. I see no problem with Rob. He did very well in class. His test grades aren't real good. That's what lowers his . . . his total grade. As far as his ability to get along with other kids, I see no problem. He's very co-operative, and very helpful, and he's always the first one to help any of the other special needs students in the class. He never has a bad thing to say about anybody. If he has something to say, it's . . . it's good, or he doesn't say anything at all. And, he's worked very closely with another visually handicapped student in there. He . . . he (Rob) was just, you know, a really nice kid; discipline was no problem. He was there all the time. His final report, when he brought in the computer, he really . . . you could tell he really enjoyed what he talked about. He did very well on his project. I was trying to think here. Let's see, what did he get on his paper? (She looked into the grade book, on which she had been working when I came to talk to her.) He got an "A" on his paper. He did a really nice job presenting it orally, and

it . . . through his written work he did very well. Well, it was all done on the computer, too.

Marquis: Okay, so he did complete that project. Did any of his other homework come in from the computer?

Ms. Wilson: Um, no.

Marquis: Workbook pages, pretty much?

Ms. Wilson: Very few of it. That was a problem. Rob did not do a real lot of the homework. And maybe it was because it was not, you know, it was hard for him to read, or something. But he . . . that's another reason his grade was lower. His test grades and his homework, um, is what lowered it a little bit. His cooperation and attitude in class was very good. I had no complaint about that.

Marquis: But he didn't get you all the homework?

Ms. Wilson: Mm-hm.

Marquis: Okay.

Ms. Wilson: I see some zeroes as I glance here.

HV1701 Marquis, Jeanne Glidden.
M348 Microcomputer usage by a
c.1 low vision student: a
case study.